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Power Engineering

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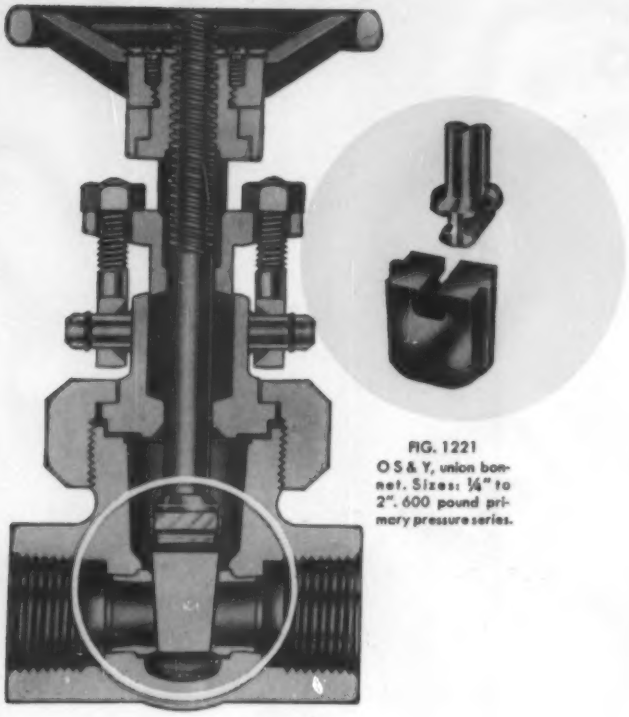

FIG. 1221
O S & Y, union bonnet. Sizes: ¼" to 2". 600 pound primary pressure series.

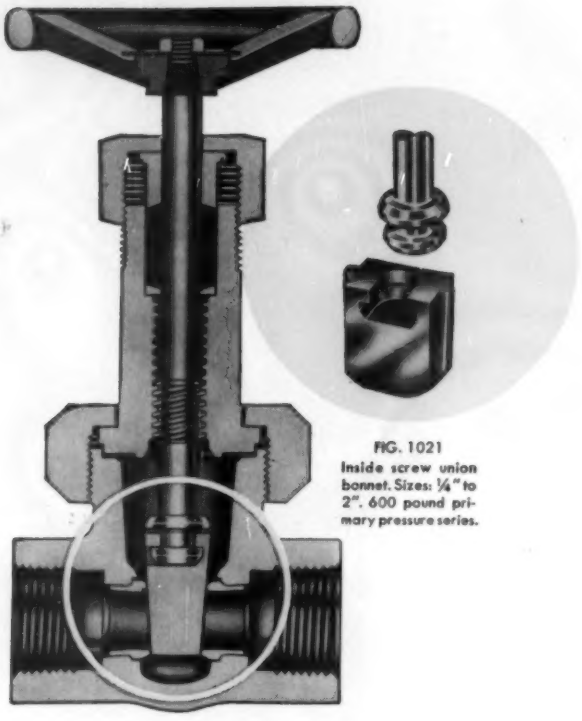

FIG. 1021
Inside screw union bonnet. Sizes: ¼" to 2". 600 pound primary pressure series.

New design makes OIC forged steel gate valves the most modern line . . .

NEW: stronger stem-to-wedge connection. Improved, modern design increases pull-out strength to many times the theoretical requirement. This design distributes the pull-out load more efficiently throughout the wedge structure to meet the most stringent specifications of valve buyers in all fields.

NEW: wedges wear longer. Wedges are made of 13% chrome stainless steel for corrosion resistance. They are duracased to at least 1000 Brinell Hardness to prevent galling and excessive wear caused by frequent closures upon foreign particles in the flow.

NEW: union bonnet design is more efficient. Body-to-bonnet joint of the male-female type provides a recess for the gasket. It is contained more securely, reducing the possibility of leakage or a blown gasket.

OTHER OUTSTANDING FEATURES

Stem threads of all OIC inside screw, forged steel valves are always contained inside the bonnet. They can't possibly load up with corrosive matter which might be in the flow. This keeps the threads clean and free running, and contributes to longer stem wear.

Modern OIC Seal-Ever packing is a special composition which eliminates electrolytic action between the stem and the packing. This prevents stem corrosion in the packing area and helps maintain a leakproof seal.

Back-seating feature provides means of repacking valves while in service.

OS & Y valve gland "I" bolts are retained on trunnions by modern, more efficient, stainless steel snap rings.

Shoulder-type seat rings are expanded into the body under heavy pressure. They are accurately machined to mate tightly with the wedge for a positive seal.

Order modern OIC Forged Steel Valves from your nearby OIC Distributor. Write and request Folder No. 195.

OIC Forged Steel Valves are also available in globes, angles and checks in a variety of trims for any service.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC
FOUNDED 1887
VALVES

FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON

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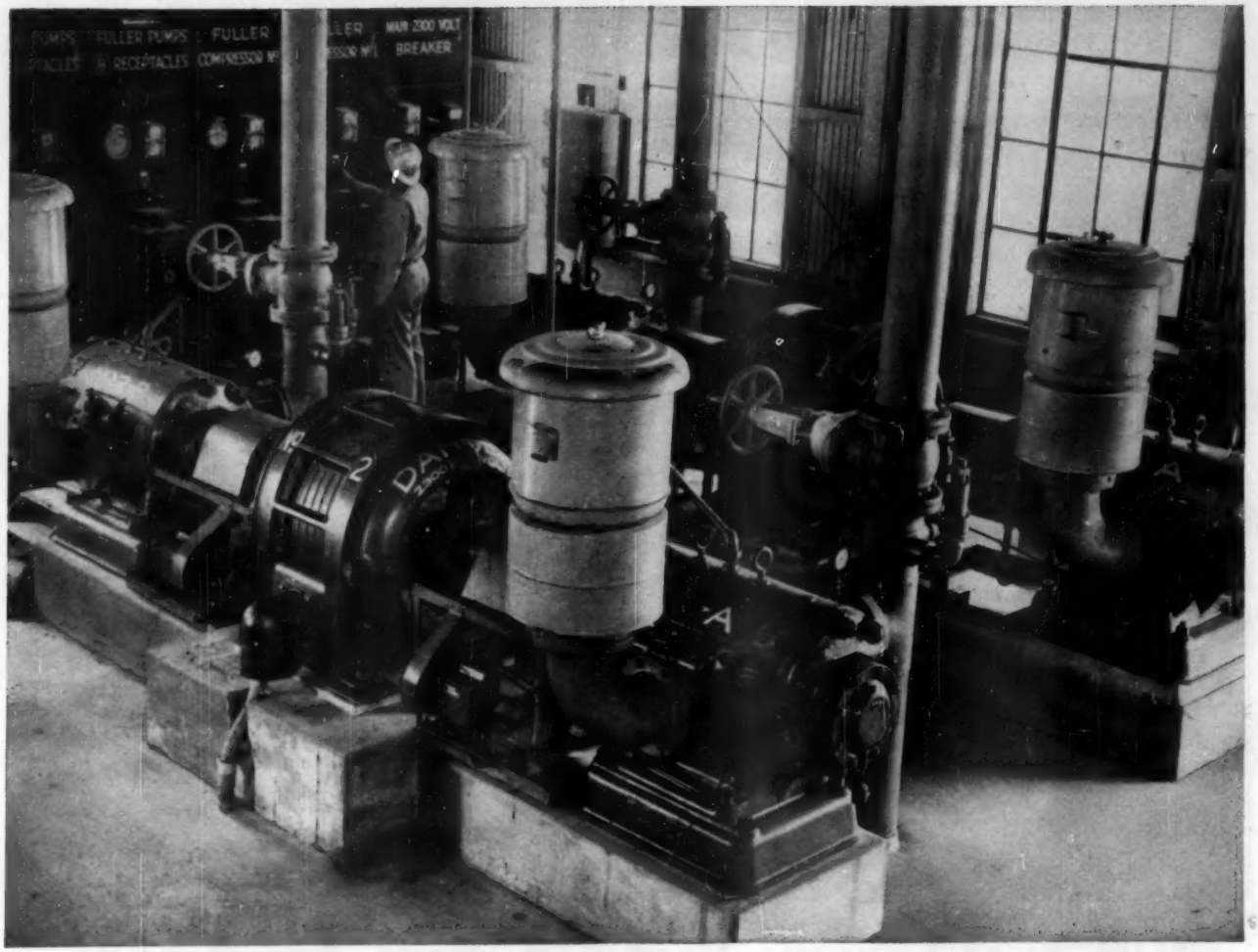

Fuller® Rotary Compressors operate with minimum maintenance cost

Fuller Rotary Compressors installed in the Permanente Cement Company's bulk-cement storage and ship-loading plant at Redwood City, California, do yeoman duty supplying air to the Fuller-Kinyon Conveying System installed in the plant. These two Fullers, illustrated above, are of the single-stage duplex type, each having a capacity of 2040 c.f.m., actual free-air delivery, with 40-lb. discharge pressure.

These compressors are kept busy. During the year 1953, the Redwood City plant shipped approximately 2-3/4 million barrels of cement; however, the Fuller Rotary Compressors supplied the air to the Fuller-Kinyon System for handling it twice—incoming to storage and outgoing from storage to ships—for a total volume of approximately 5-1/2 million barrels. And, this mammoth task was accomplished with a total maintenance cost of only $130.00 for both machines!

Such operation is the result of two important factors: (1) equipment designed and built to give satisfactory service under all kinds of working conditions; (2) careful overall supervision of the equipment, and good housekeeping by the operating personnel in the plant.

In this operation it is highly essential that these compressors operate at the highest efficiency when ships are being loaded, because wharfage charge is $2.00 for every minute the ship is tied up to the wharf, in addition to operating cost of the vessel.

Thousands of Fuller Rotary Compressors are operating in various industrial plants, giving unqualified satisfaction and service, day in and day out. They're built in single and two-stage units for capacities to 3300 c.f.m., pressures to 125 pounds. Write for Bulletin C-5A, for a complete description of these modern machines.

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FULLER COMPANY, Catasauqua, Pa.

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C-257
1170

PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS

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The Steam Traps That Didn't Cost a Penny . . .

10% Fuel Savings Paid for These Armstrongs

Nobody loves the coal man—When you can save 2000 to 3000 pounds of coal per day, it doesn't take long to completely pay for an Armstrong steam trap installation. That's the way it worked at Beloit Boxboard Co., Beloit, Wisconsin. Mr. Edward Kasten, Plant Engineer, is shown above pointing to a No. 812 Armstrong trap, list price $23. Every 3 or 4 days one of the traps pictured was paid for in full at the expense of the coal man. For a bonus, there had been absolutely no repair costs on these traps at the end of three years service.

Are such savings common?—More often than not, the replacement of leaky or obsolete or improperly sized steam traps with new Armstrongs results in worthwhile fuel savings. Some of the best engineered plants in the country have experienced this.

The reasons—Start with a good steam trap design. Add to it shop men who have made more industrial steam traps than any other group in the world. Then, add to that the best trained, most experienced trap sales-engineering group in existence. Season the whole affair with the Armstrong unconditional guarantee of "complete satisfaction or your money back". You can't buy any product anywhere with closer to 100% assurance that it is going to give you good results. In the case of steam traps, one of those results is often fuel savings.

Why not take another good look at your trapping? Call your local Armstrong Factory Representative (listed in many classified phone directories and in Thomas Register), or write to Armstrong Machine Works, 810 Maple St., Three Rivers, Michigan.

Application Engineered

ARMSTRONG STEAM TRAPS

ASK FOR CATALOG J

. . . the 44-page "Steam Trap Book" is really a handbook of steam trapping—trap data plus selection, installation and maintenance information. Free on request without obligation.

Armstrong traps also catalogued in Sweets and Chemical Engineering Catalog.

For more data circle 503 on Post Card

ENGINEERS' PREVIEW

AT BUCKEYE, Arizona, in the Salt River Valley district, a test well recently showed 4,500 ppm of soluble salts. So you can see that the Valley is properly named. Anyway, Ionics, Inc., is running some field tests under a contract with the Department of Interior as part of the government's saline water conversion program. Ionics has a water demineralization apparatus using an electrical membrane and is going to see what can be done to make brackish waters drinkable.

. . .

CAN YOU GIVE orders that get action? Do you know how to make the order clear and complete? Do you know how to make it fit the person; can you make it business-like and can you make it easy to take? If not, a little booklet entitled "You Can Give Orders That Get *Action!*" can be obtained for 25¢ a copy from the National Foremen's Institute, 100 Garfield Ave., New London, Conn. It tells you in a down-to-earth manner how to do it.

. . .

IN A PROJECT to develop engineering design data on spray type dust collectors for stacks of commercial and industrial plants, Diamond Power Specialty Corporation of Lancaster, Ohio has become a co-sponsor with Bituminous Coal Research, Inc. Objectives are to reduce stack emission during soot blowing at boiler plants, minimize corrosion and other forms of stack deterioration caused by water sprays, and publish engineering data to help boiler plants operate within city stack-emission requirements. Test work has already started, but no public reports are anticipated until later in 1955.

. . .

GENERAL ELECTRIC CO. has received an $11,000,000 order to supply eight large hydraulic turbine-generators for The Dalles Dam, U. S. Army Corps of Engineers project on the Columbia River. Shipment of the first 78,000 kw unit is scheduled for September 1956, with the eighth unit scheduled to be shipped in October 1958. The machines for The Dalles project are similar to 12 generators for the McNary Dam project.

. . .

HOW CAN our technical manpower be best utilized in the interests of our national welfare? To discuss that question, a very important convocation of the top leaders of our industrial, military, governmental, educational and engineering activities will be held February 10 and 11, 1955, at the Conrad Hilton Hotel, Chicago, Illinois. The Society of American Military Engineers, cooperating with all the above groups, has provided the impetus for this conference.

This country is only now waking up to the fact that all is not well in our handling and training of young engineers from the point of view of our national security, as well as for the welfare of the engineering profession itself. Our situation, particularly as compared to Russia's, was brought out in the article Russian Technology Is Very Good, December issue, page 65. Only recently have we accumulated enough data on this subject to give us an accurate picture.

As a result, the leaders of United States governmental, industrial, educational engineering and military organizations are now thoroughly aroused. They are increasingly feeling the shortage of technically-trained manpower, which could well be the deciding factor in another national emergency.

General Chairman of the convocation is Lenox R. Lohr, president of

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the Museum of Science and Industry, also president of The Society of American Military Engineers.

For full particulars, program of the conference and advance registration card, write to Daniel A. Sullivan, director, The American Society of American Military Engineers, care of Commonwealth Edison Company, 72 West Adams St., Chicago, Illinois.

• • •

IF YOU EVER have to take any part in setting up an apprenticeship program in your plant or industry, don't forget that the United States Department of Labor has for many years given industries most practical co-operation in doing this. They have a new edition of a very valuable booklet entitled "Setting Up An Apprenticeship Program" which outlines the various steps in establishing and placing it in operation in a way best suited to your needs. Copies of the booklet may be obtained, free of charge, from the Publications Branch, Bureau of Apprenticeship, U. S. Department of Labor, Washington 25, D. C.

• • •

FOUR FORMER NAVY MEN on the editorial staff of POWER ENGINEERING — two old ones from World War I (O! THAT war!) and two from World War II — are much interested in a recent union between the ancient art of ship design and the science of oceanography. First they learn that an electronic instrument that accurately measures energy and frequency of ocean waves has developed at New York University's College of Engineering. Next they learn that St. Denis and Pierson of the Taylor Model Basin and New York University, respectively, have written an unusual pioneering paper on Motions of Ships in Confused Seas described as a milestone in the development of a proper understanding of the sea-keeping characteristics of ships. Now what these four ex-black-gang veterans want to know is when all this can be combined into some kind of a sea-sickness-ometer so you can predict when you are going to get sea sick, how sick you are going to get, and what of it. Of course, if you're going to take dramamine anyway, you won't need the meter. And, of course, good sailors don't get sea sick unless they have spent too much time ashore in the bistros.

MULTI-HOP MICROWAVE radio relay system by RCA will soon link the Utah Power and Light Co., at Salt Lake City, with hydro-electric plants at four Utah locations. The installation will utilize RCA CW-20 microwave radio equipment to provide the major portion of circuits necessary to operate an extensive load-control and telemetering system, and to replace portions of a privately-owned wire-line system used for voice communications.

• • •

IN A RECENT SPEECH before the Society of Associated Industrial Editors, Edward C. Logelin, vice president of U. S. Steel Corporation reported the following:

"Last March I attended the annual convention of the American Society of Bakery Engineers in Chicago. They used a unique device to remind speakers of their responsibilities. As you stood at the rostrum you could see a huge sign stretched across one wall of the large meeting room. This is what it said:

" 'In promulgating your esoteric cogitations, or articulating your superficial sentimentalities, amicable, philosophical or psychological observations, beware of platitudinous ponderosity. Let your conversational communications possess a clarified conciseness, a compact comprehensibleness, and a coalescent consistency. Let your extemporaneous descanting and unpremeditated explanations have intelligibility and veracious vivacity without rodomontade or bombast. Eschew all conglomerations of flatulent garrularity, jejune babblement and asinine affectations. Sedulously avoid all polysyllabic profundity, pompous prolixity, and psittaceous vivacity, clumpish ocosity, and pestiferous profanity. In other words, make it brief, clear, crisp, truthful.' "

LETTERS TO THE EDITORS

Some More Angles on Lightning Protection

THE GENERAL DETAILS of the article on Lightning Protection, Oct. issue, p. 96, agree with more or less uniform practice. However, the following experiences may also be of interest. My comments will refer to the sketches shown in the article.

For Fig. 2, a building as indicated might be more effectively protected, particularly if it is of sizeable dimensions, by two air terminals or even four, one for each side and the tops interconnected similarly to Fig. 3. Networks over oil tanks have been found most effective but in addition, even for Fig. 6, effective bonding of the cover of a metal tank with the vertical sides at two and preferably at four points ought to be considered.

In a severe lightning area, down leads of not less than 2/0 conductor were provided and the cost was relatively small in the total installation. For Fig. 4, an additional fence ground on side "H" should be considered. If Fig. 6 is a wood tank, two or four side air terminals with substantial down-lead ground connections are well worth consideration.

Maintenance of low ground resistance is a most difficult condition to overcome, particularly where the soil is sandy and where torrential seasonal rains often nullify the efforts toward maintenance by washing away the substance, salt or other material used. For one station of importance, however, an elevated tank filled with salt solution and piped to points where it could be dripped on the grounds was of great help. This is not a new approach in any sense. To the best of my knowledge it was used by C. P. Steinmetz and an associate, E. J. Berg, years ago. — *C. O. von Dannenberg, Brooklyn, N. Y.*

Motor, Grinding Wheel, Can Sub for Cutting Tool

THE SEPTEMBER issue of POWER ENGINEERING, page 81, has an interesting article by Mr. Emil Stumpp on Truing Collector Rings. His method is very similar to that practiced here at Standard Oil Company of Indiana. One difference is that where Mr. Stumpp mounts a cutting tool on the compound tool rest, our mechanics mount a small motor with a grinding wheel. The turbine is operated at full speed during the grinding. The result is a fast, accurate, and highly polished job in one operation. — *Edwin S. Isberg, Whiting, Ind.*

E. A. Hamann (left), Power Generation Engineer and Robert Best (right), Superintendent of Utilities, go over lubrication records with Bill Schall, Standard Oil lubrication specialist. Bill Schall has been providing technical sales service to Standard Oil customers since 1943. Bill is an engineer with a B.S. in engineering from Georgia Tech., and a graduate of Standard's Sales Engineering School. Customers of Bill's find this experience and background pay off *for them.*

Anheuser-Busch still using same turbine oil after 24 years

...NONPAREIL

For more than 24 years the Anheuser Busch Brewery, St. Louis, Mo., has been operating two 3,000 kw., turbines using NONPAREIL Turbine Oil. Three more turbines added to the system in 1940, '48 and '51 have also used NONPAREIL since beginning operations. The reason for choosing NONPAREIL is clear; it is guaranteed for the life of the turbine.

Since the initial installation, Anheuser Busch has not had to replace a NONPAREIL Turbine Oil fill. Neutralization number is always far below 0.15 mg. KOH/g., the degree of acidity Standard Oil guarantees NONPAREIL will not exceed. At nearly all times neutralization number is on the order of 0.03 mg. KOH/g. (See chart).

In all these years, oil systems have remained clean. There has been no problem of oil acidity in any of the five turbines. The delicate art of brewing world famous Budweiser goes on without concern over power failure due to lubrication failure.

Like to know more about NONPAREIL and its possible use in your turbines? In the midwest call your nearby Standard Oil lubrication specialist. Or, contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Anheuser-Busch Turbine Lubrication Record

Generator Capacity	Start up and NONPAREIL Installation Date	Date of Last Oil Analysis	Neutralization Number
3,000 kw.	Oct. 2, 1930	July 20, 1954	0.03
3,000 kw.	Oct. 2, 1930	July 22, 1954	0.02
2,500 kw.	June 10, 1940	July 20, 1954	0.03
7,500 kw.	Jan. 2, 1948	July 22, 1954	0.03
7,500 kw.	July 26, 1951	July 22, 1954	0.01

STANDARD

STANDARD OIL COMPANY
(Indiana)

For more data circle 504 on Post Card

HERE'S WHAT THEY TELL US

W. G. CRAMER, vice-president, The Marley Company, expressed hearty approval of POWER ENGINEERING's movement to preserve the first atomic reactors located in the Argonne Woods. In his note he said:

> By all means, the atomic piles and historic buildings should be preserved in Argonne Woods. Please continue your good work to preserve these historic monuments for the future.

. . .

C. H. SPINK, top hydraulic power planning and design engineer of Federal Power Commission in Fort Worth, wrote us during the holidays:

> December POWER ENGINEERING was wonderful!

. . .

D. J. CRUMLISH, Engineering Dept., Supplee-Wills-Jones Milk Co., asked us for recent information on the use of gas turbines. Executive Editor Chester Earle replied:

> While there is a great deal of material available, it is somewhat scattered. We have published a great deal of it in POWER ENGINEERING, of course. Latest item: Williston Oil Boom Powered by Gas Turbines, November issue. We'll send a list of our recent articles. The American Society of Mechanical Engineers has published a large number of papers dealing with both the design and application of gas turbines.
>
> A relatively new book, Theory and Design of Gas Turbines, was published in 1953 by John F. Lee, Associate Professor of Mechanical Engineering of the North Carolina State College. Essentially a textbook for mechanical engineering students, it is quite a good book outlining the basic principles of the gas turbine.
>
> Another good book, Gas Turbines by Harry A. Sorensen, has perhaps a more practical approach.

. . .

CURTISS D. BASSETT, of Cummins & Barnard, wondered about the failure of the piping in the *Nautilus*. Editor Kramer said:

> All I know is that when I went through the prototype of the *Nautilus* power plant at the Reactor Testing Station in Idaho, a year and a half ago, everything seemed to be working all right, and since this power plant was exactly the same as the one which was subsequently installed in the *Nautilus*, I don't see why the piping should have failed. I assume the failure occurred in the high-pressure water heat transfer system. This water, of course, is at 2000 psi and at high temperature.

. . .

ANOTHER READER requested the name of a book covering high-pressure boiler operation. We didn't know of any confined solely to high-pressure operation. Today that could mean almost anything from 450 psi to the latest plans for 5000 psi boilers.

But we did suggest some of our own handbooks, also the following general books on boiler plant operation, containing data that apply to operation of all types of boilers at almost any pressure:

1) Boiler Operators' Guide, by Spring.

2) Steam Plant Operation, by Woodruff & Lammers.

We also mentioned the importance of referring to the latest edition of the ASME Code for Power Boilers (1952), and the Suggested Rules for the Care of Power Boilers published in 1954.

. . .

J. L. ANTHONY, Plant Engineer, Twin Coach Co., said:

> As I was reading over the October issue of POWER ENGINEERING I came across the new section on the POWER ENGINEERING Handbook. I believe this information is going to be of great value to everyone concerned.

. . .

COMMENTING on the ratio between a pound of active fissionable material and the ore from which it is refined, Editor Andrew Kramer wrote C. O. von Dannenberg:

> I have never seen any definite figures but I think that the ratio is probably comparable to the ratio of refined silver to the ore from which it is obtained. That is, as far as the rich deposits we are now using are concerned.
>
> The energy concentration in a uranium fuel is so stupendous that the ratio between the refined uranium metal and the ore could be very large and still have the extraction process economical. When you have a fuel where the energy concentration is such that the energy in a cubic inch weighing a pound is equivalent to that obtained in a whole train load of coal — that is, some three million pounds — it is obvious that you can spend a lot of money in refining it.

. . .

EDITOR KRAMER'S second broadcast, Atomic Energy, took place January 5 on Meet the Engineer program, WFLN, Philadelphia.

. . .

JOHN W. LEBOURVEAU, Assistant Engineer, New England Power Company, appreciated the article in POWER ENGINEERING's December issue entitled Russian Technology Is Very Good. But he also said the most obvious solution to the problems of attracting greater numbers of our young people to the scientific and technical fields on a professional level has been entirely overlooked:

> Under our capitalistic system, talent and investment tend to flow in those directions where the opportunity for financial reward is the greatest. If the law of supply and demand is still valid, larger numbers of our young people will become interested in these careers as soon as they believe that the salary level compares favorably with that of business generally.
>
> Business and government must augment their expressed concern over a shortage of technical talent by higher salaries. With this incentive, military deferments will be unnecessary and so will pep talks by industrialists, school teachers and others.

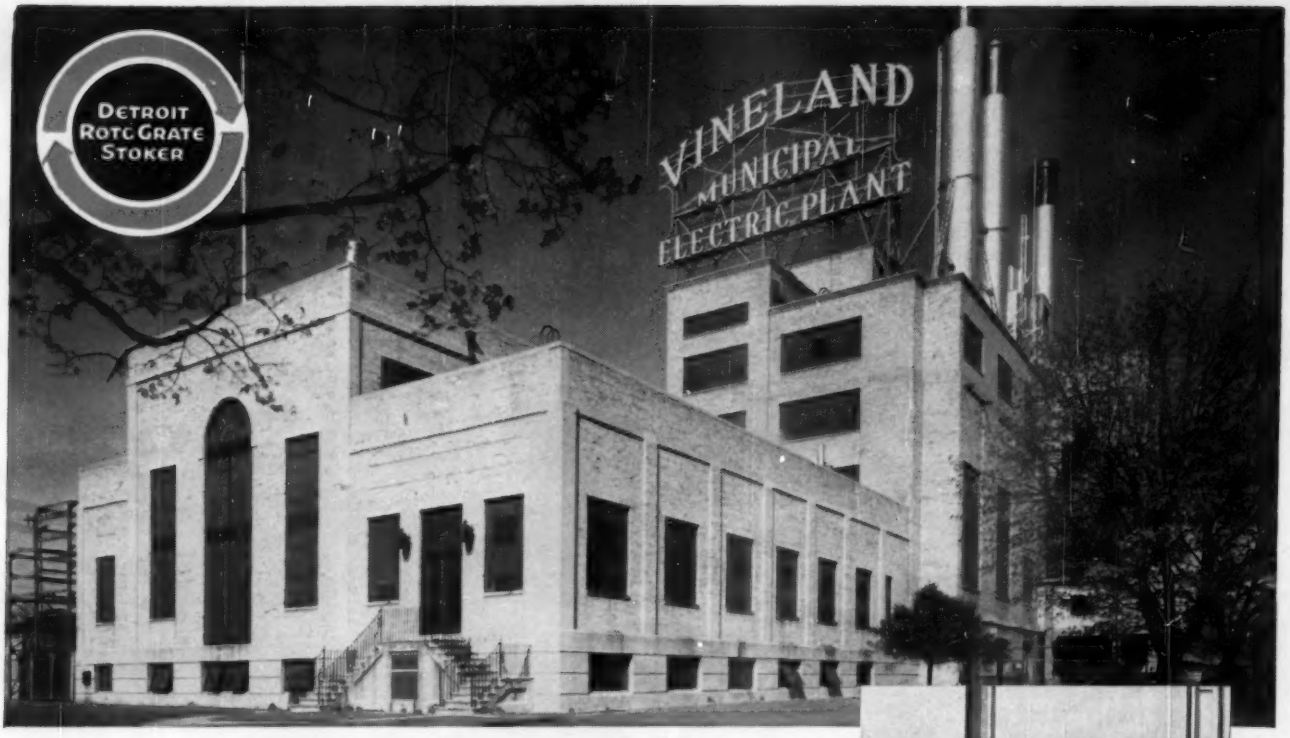
Editor Kramer, in reply said:

> . . . the law of supply and demand will have to work vigorously to be of any material help in the little time at our disposal. We do not profess to know the answers to these problems but we feel very strongly that people should begin thinking about them very seriously.

. . .

IN ADDITION to your problems of power engineering, perhaps you, too, are trying to eliminate the noise from your old phonograph records. The following is off the power-engineering beam, but it was included in a note we sent to a Philadelphia reader:

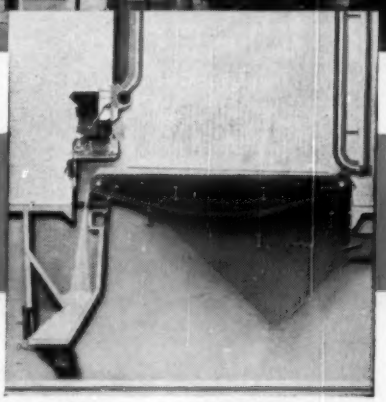
> Mr. K. can overcome most of his difficulties in eliminating noise from his old phonograph records if he uses a continuously-variable-band-width amplifier of the type made by H. H. Scott at Cambridge, Mass. Scott's method of dynamic noise suppression virtually eliminates record scratch, hiss, and turntable rumble without much sacrifice in audio fidelity.
>
> This type of amplifier continually measures the volume level of the record and adjusts the filter so that it filters out the noise during low-level passages, even between individual notes. Homer Scott developed this system as far back as 1947.



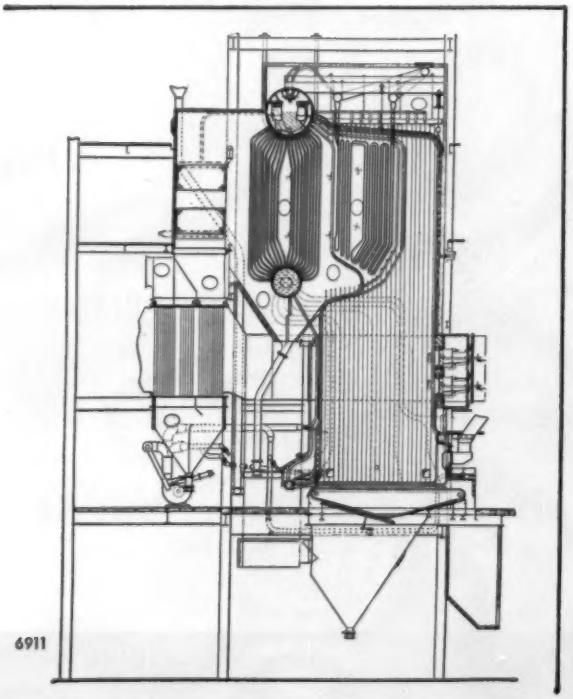
Vineland Municipal Electric Plant; Howard M. Down, General Manager of Municipal Utilities.

Fuel Savings by First Installation

BRING SECOND CONTRACT AT VINELAND MUNICIPAL ELECTRIC PLANT VINELAND, N. J.



Detroit RotoGrate Stoker—the original spreader stoker with forward moving grates that continuously discharge the ash at the front.



6911

In 1950 this plant installed its first Detroit RotoGrate Stoker with a B&W Two-Drum Stirling Boiler with Superheater, Economizer and Air Heater; designed for a capacity of 100,000 pounds of steam per hour . . . 625 psi . . . 835°F . . . feedwater 354°F. Burners for auxiliary oil burning are provided.

Substantial economies produced by this unit resulted in a second order for a Detroit RotoGrate Stoker. This second unit is for a similar B&W Boiler of 130,000 pounds of steam per hour capacity . . . 875 psi . . . 910°F . . . feedwater 390°F. Design is based on eastern bituminous coal—12,700 BTU, with air preheated to 300°F.

This repeat order was based on the solid performance for which Detroit Stokers are noted.

They can save *you* money. Write for recommendations. No obligation.

DETROIT STOKER COMPANY

General Motors Building—Detroit 2, Michigan

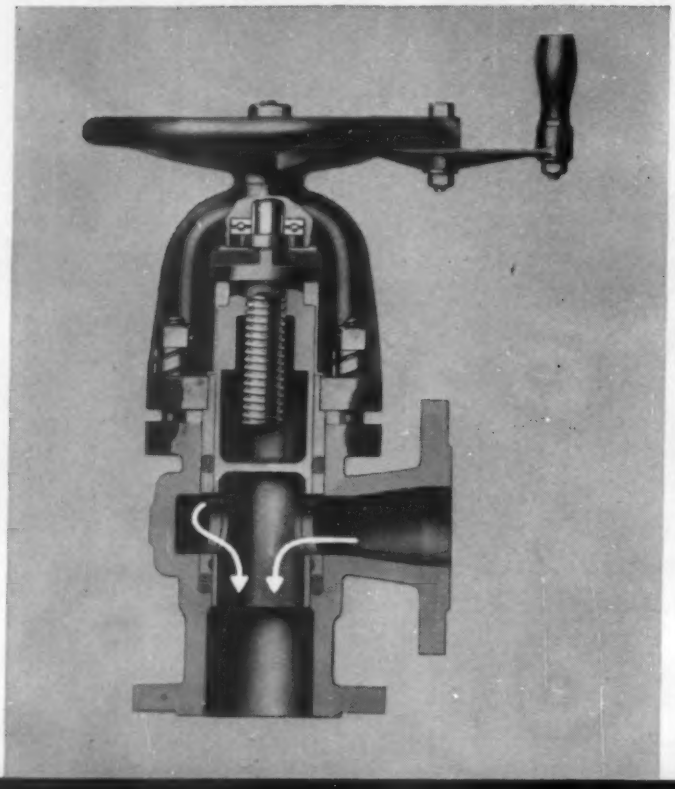
District Offices in Principal Cities • Works at Monroe, Michigan

For more data circle 505 on Post Card

These YARWAY VALVE DESIGNS

YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

USED IN OVER 15,000 BOILER PLANTS

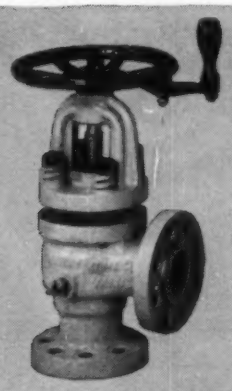
serve every boiler blow-down need

■Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

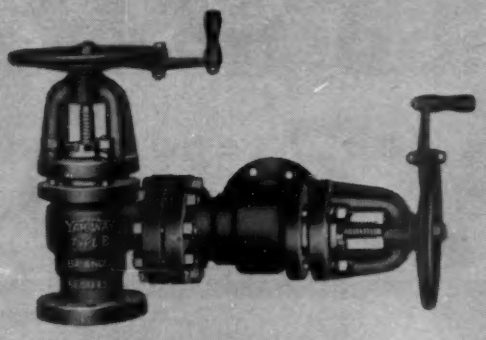
Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

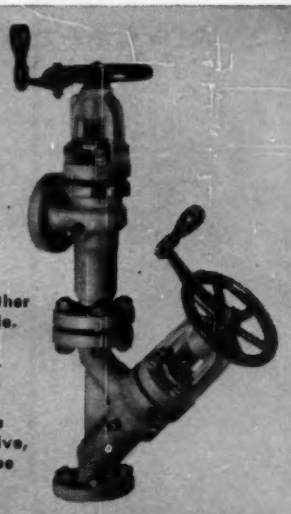
Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.



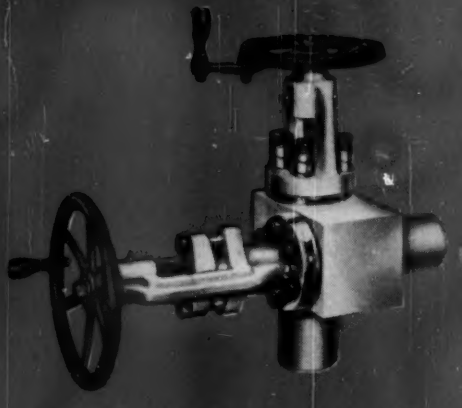
• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.



• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless sealing valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY®

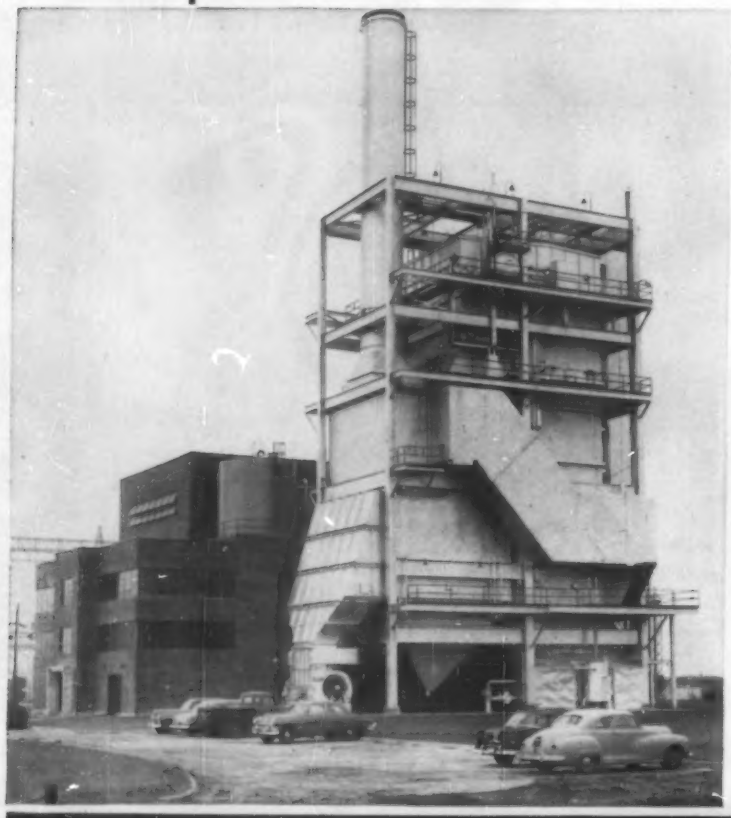
blow-off valves

AT NEW LONE STAR STATION

REPUBLIC Automatic Combustion Control

Handles Rapid Load Changes and Selective Firing of Fuels

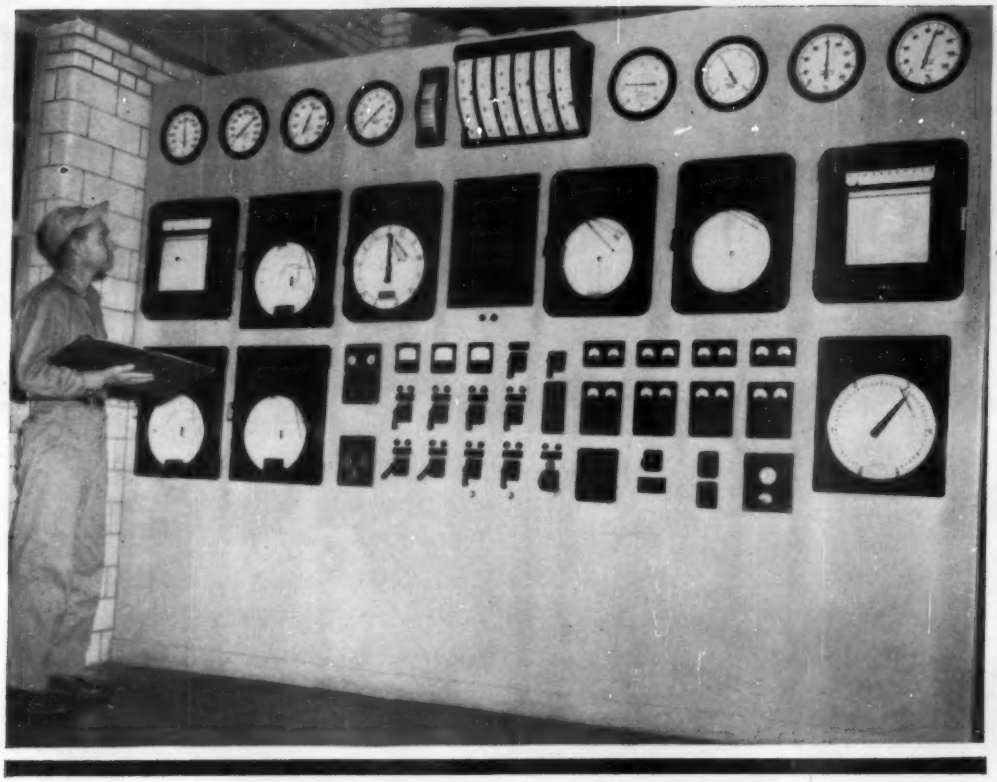
● The speed and versatility of modern electronics are bringing fast control response, easy operation and flexibility in fuel firing to Southwestern Gas and Electric's new central station near Lone Star, Texas. Placed on the line this spring, the 54,000 KW plant incorporates many of the latest ideas in power plant design, including a Republic Automatic Combustion Control System with Telemaster Electronic master control.



Lone Star Station, Lone Star, Texas
Southwestern Gas and Electric Company
Sargent and Lundy, Engineers

Steam generator is the outdoor type with a pressurized furnace. It is designed for maximum steam output of 470,000 lbs. per hour at 920 psig and 910° F. at the superheater outlet.

REPUBLIC FLOW METERS CO.



Electronic master controls at this panel provide for either steam pressure or steam pressure-load control, manual setting of fuel-air ratio, fuel valves, draft fans, and selection of one of four firing methods.

The plant is arranged to fire both natural and coke oven gas. Automatic fuel selector controls provide for four firing combinations:

- #1 Automatic preferential control of coke oven gas in accordance with its availability, with sequential make-up of natural gas.
- #2 Manual control of the coke oven gas proportion, with sequential make-up of natural gas.
- #3 Block or adjusted constant flow of natural gas with coke oven gas make-up.
- #4 Block, or adjusted constant flow of coke oven gas, with natural gas make-up.

Extremely fast load changes are common at the Lone Star plant. Immediate control response is possible, however, because the system uses a new type load control to get the earliest indication of a load change and provide the initial impulse for controlling fuel and air to the boiler. Electronic impulses to positioners and regulators eliminate transmission lags—enable control equipment to make immediate compensations for changing loads. Steam pressure control is also possible if desired.

According to Mr. John Turk, Chief Engineer, the electronic control system is extremely simple to operate. Operators regularly run the plant on automatic between maximum capability and a minimum load of 15,000 KW, although wide range automatic operation was not planned when the control system was designed. The three-element Republic feedwater control in the plant is left on automatic to essentially zero load.

For more complete details about Republic Combustion Controls, write for Data Book.

●

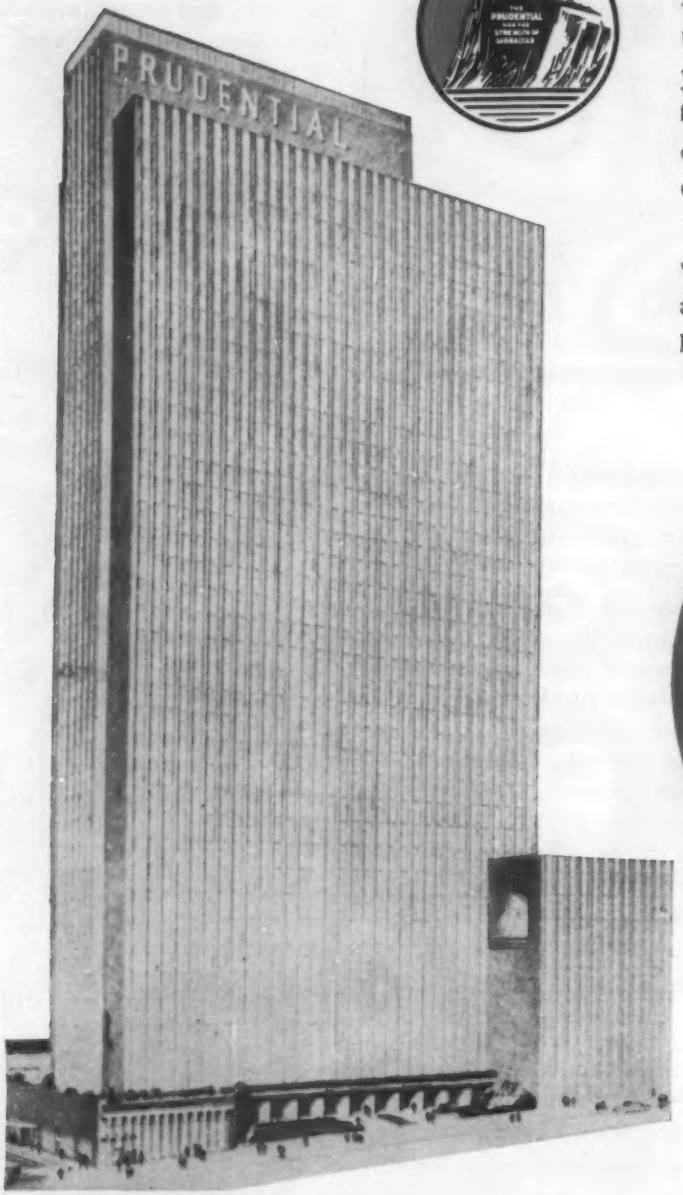
Republic brings you the latest features in Automatic Combustion Controls

- ★ **For all types and sizes of boilers**
- ★ **For all arrangements of draft**
- ★ **For all types of fuel firing**
- ★ **For all load conditions**

2240 Diversey Parkway • Chicago 47, Illinois

For more data circle 507 on Post Card

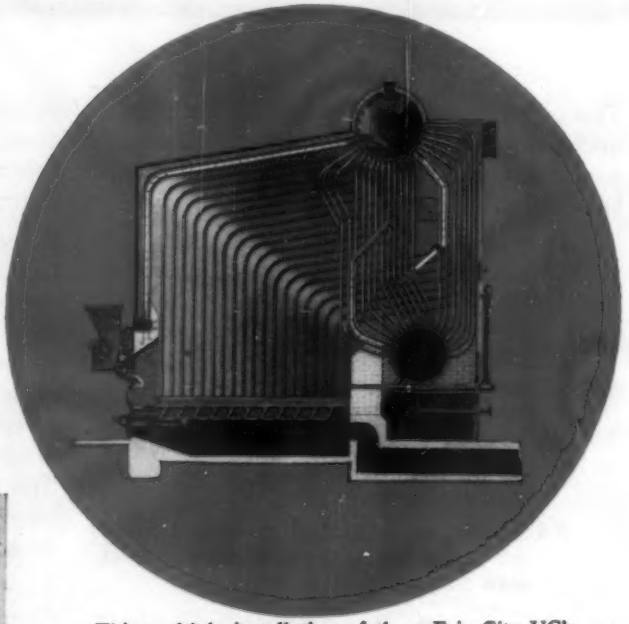
ERIE CITY *boilers used by* Prudential in CHICAGO



NAESS & MURPHY, Architects and Consulting Engineers
L. J. SHERIDAN & CO., Renting Agents

Modern, Erie City VC Steam Generators will satisfy the heating load for the most modern office building yet projected. The Prudential Building, soon to rise 600 feet into the Chicago skyline, is the very last word in office facilities. Prudential's new Mid-America Home Office is one of the largest office buildings in Chicago.

Erie City VC's, the last word in compact, completely water cooled steam generators will provide flexibility and economy of operation in meeting a variable steam heating load.



This multiple installation of three Erie City VC's, fired by Detroit spreader stokers, features completely water cooled furnaces—offers high capacity in a compact design. Erie City VC's save space, economize installation and maintenance costs. They permit a high degree of flexibility and quick response to load changes. Request Bulletin VC-4.

ERIE CITY
Fifty Years In Steam Generation

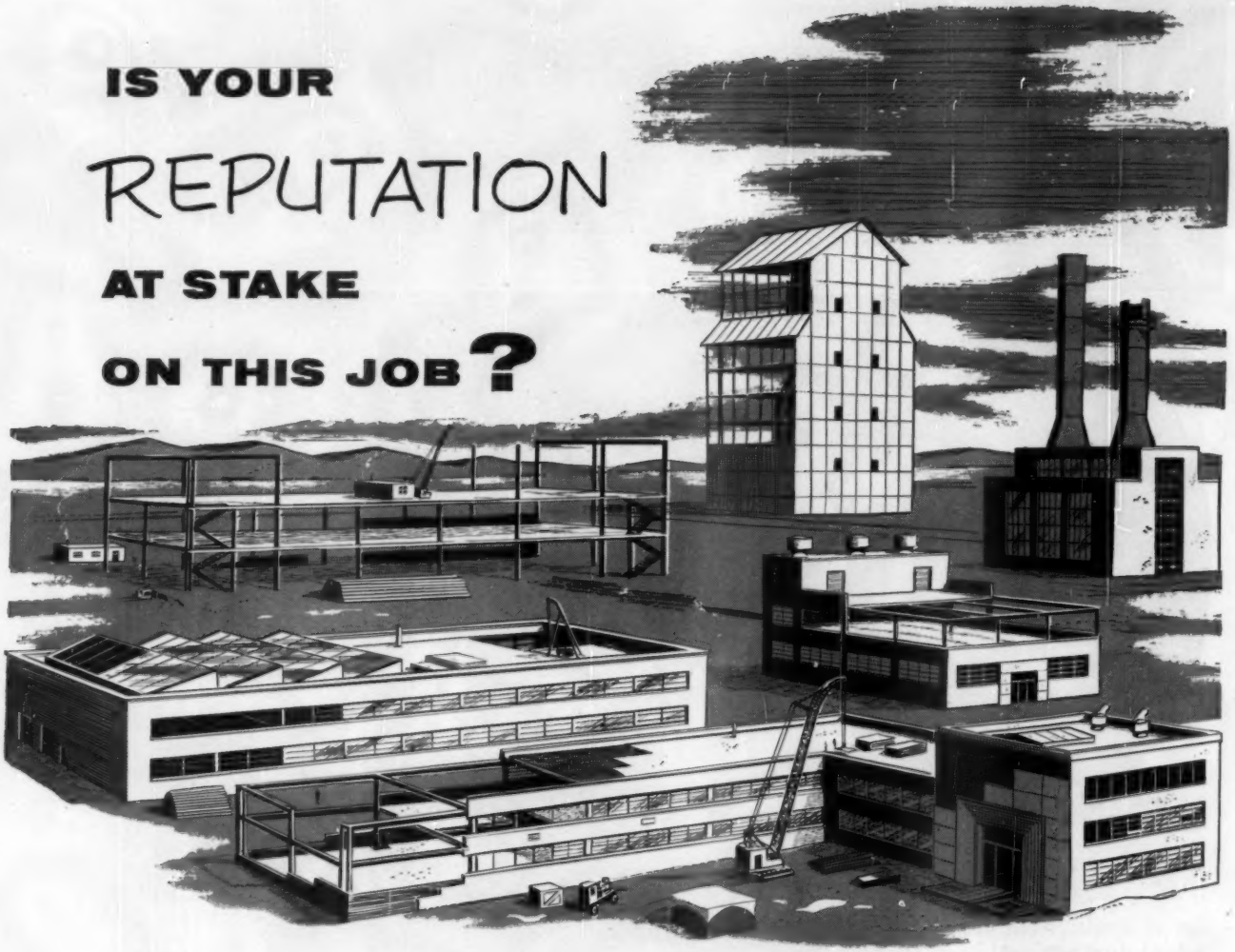
You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

For more data circle 508 on Post Card

IS YOUR REPUTATION AT STAKE ON THIS JOB?



Make-shift or hit and miss piping systems are not only costly in corrections and repairs . . . but certainly reflect on the ability of the mechanical engineer. It is *not* necessary to gamble on an efficient, long lasting insulated piping system. RIC-WIL's forty-five years in the Insulated Piping Field is your assurance of the finest piping system for both overhead and underground use. Specify RIC-WIL and be sure of the results. For complete technical information contact your nearest RIC-WIL field representative or send for the RIC-WIL catalog.

Quality Piping Systems of the . . .
. . . Highest Thermal Efficiency

RIC-WIL INCORPORATED

PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

For more data circle 509 on Post Card

"The Lower Temperature Rise of FUSETRON FUSES Solved a Serious Shutdown Problem for Us"

J. F. Getz
Chief Engineer,
University of Denver
Denver, Colorado

"The fine, new Field House we built in 1949 included an ice skating rink. The ice making equipment uses two 3 phase, 220 volt, 100 hp., compressor motors having a running current of 246 amperes.

"Ahead of the magnetic starters for these motors were two 400 ampere safety switches originally equipped with 400 ampere renewable fuses.

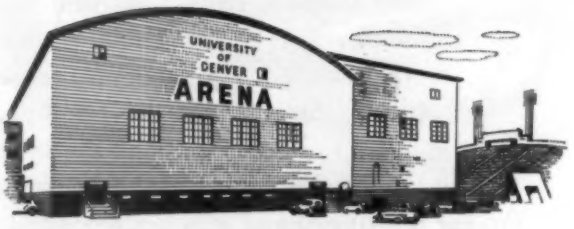
"Shortly after the compressors went into service heat began developing in the safety switches. The fuses were running very hot — in fact to such a degree that the links in the fuses were melting and causing as many as three shutdowns a week.

"In August of 1951 I saw a demonstration by a BUSS representative that showed how much cooler was the operating temperature of Fusetron fuses.

"Right then, I determined to try out Fusetron fuses in these two switches. To get better protection I dropped the fuse size down to 300 amperes.

"With the installation of Fusetron fuses the heating immediately disappeared and so did the shutdowns it formerly caused.

"The lower temperature rise of Fusetron fuses solved a serious shutdown problem for us."



YOU TOO, CAN MINIMIZE PLANT SHUTDOWNS AND EQUIPMENT LOSSES BY INSTALLING FUSETRON FUSES — THEY GIVE 10 POINT PROTECTION

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

And with FUSETRON FUSES you have Greater Safety, because of their 100,000 amp., Interrupting Capacity Rating

Tests verified by the Electrical Testing Laboratories of New York show that Fusetron fuses, on loads under 600 amperes, can interrupt safely the most severe available short circuit currents.

The test circuits were set to deliver far in excess of 100,000 amperes — yet the 250 and 600 volt Fusetron fuses on each and every test cleared the circuit without igniting readily flammable material placed around the fuses . . . and there was comparatively little noise.

You get all this added safety for every set of fuse clips in your plant without changing a panelboard or switch

No Interference with time-lag

Fusetron fuses' time-current characteristic, of the utmost importance to give proper motor and electrical protection and to eliminate needless blows, has in no way been disturbed.

Maximum Safety

With Fusetron fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every Fusetron fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to pay extra for "safe" equipment. Wherever a Fusetron fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

Once properly installed Fusetron fuses are maintenance free. They require no costly inspection or down-time for calibration and other maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

No Recalibration Costs

When a Fusetron fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS — a fuse that is as safe and dependable as the one that blew.

For High Interrupting Capacity above 600 and up to 5000 amps. — Install BUSS Hi-Cap Fuses

BUSS Hi-Cap fuses offer unlimited interrupting capacity for circuits of 600 volts or less. Their high speed operation on heavy shorts limits current to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with Fusetron fuses they will not open ahead of the fuse nearest to the fault—thus the trouble is isolated to the part of the circuit in which the fault occurs.

Added Safety on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

PLAY SAFE—Install FUSETRON Dual-Element Fuses and BUSS Hi-Cap Fuses throughout the entire electrical system . . . Today!

One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with a Fusetron fuse on loads up to 600 amps — and BUSS Hi-Cap fuses on loads above that.

Blowing time charts and more information are available. Write for bulletins FIS and HCS.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN Mfg. Co.
(Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me complete facts about FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 155

For more data circle 510 on Post Card

This Tough, Trouble-Free Belt Takes Heavy Loads In Stride

Here's an economical, tough belt for hauling heavy loads of coal, ores or aggregates in operations where long conveyor centers are necessary. Its troughability is good and its fastener holding is superb.

A sturdy, multiple-ply, rayon duck carcass makes this belt lighter and thinner than cotton-carcass belts of comparable strength. Skim coats between plies insure perfect bonding.

Like other heavy duty belts, these LOADLINER belts are custom made to meet particular requirements of individual jobs — unlimited length, widths to 72". They can be made with a cover tensile strength of 3500 to 4000 pounds average and a friction pull of 20 to 24 pounds; or with a cover tensile strength of 2500 to 3000 pounds and a friction pull of 16 to 19 pounds; also available in oil-resistant Neoprene. All are mildew inhibited throughout. A breaker strip can be included in top cover, if specified.

We also manufacture a complete line of industrial rubber products: belting, hose, packing and moulded rubber of every construction for every need. *Through your Quaker and Quaker Pioneer distributor* our research and engineering services are always available to help you solve any industrial rubber problem. *Write for name of nearest distributor.*

QUAKER RUBBER CORPORATION
Philadelphia 24, Pennsylvania

HKP

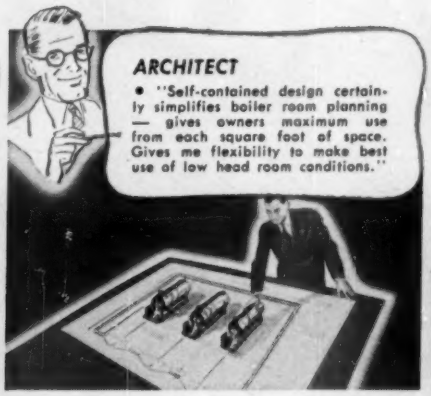
QUAKER PIONEER RUBBER MILLS
San Francisco 7, California

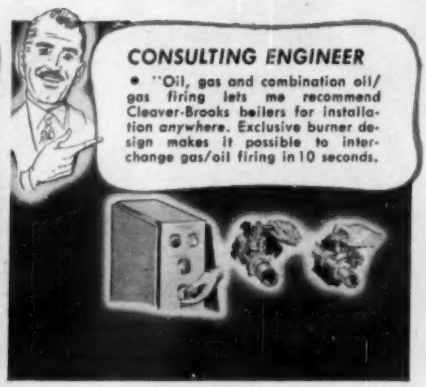
For more data circle 511 on Post Card

CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

...which feature would be most important to you?

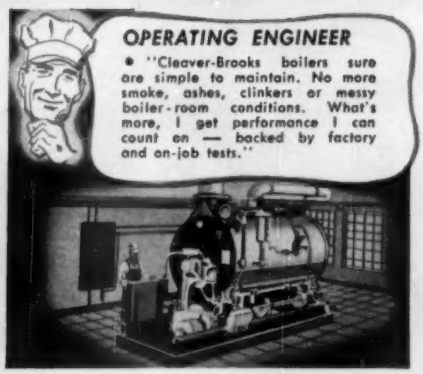
PLANT OWNER
• "Cleaver-Brooks boilers are tops in fuel economy! Forced-draft, four-pass construction and 5 sq. ft. of heating surface per boiler H.P. assure me 80% operating efficiency when firing with oil."

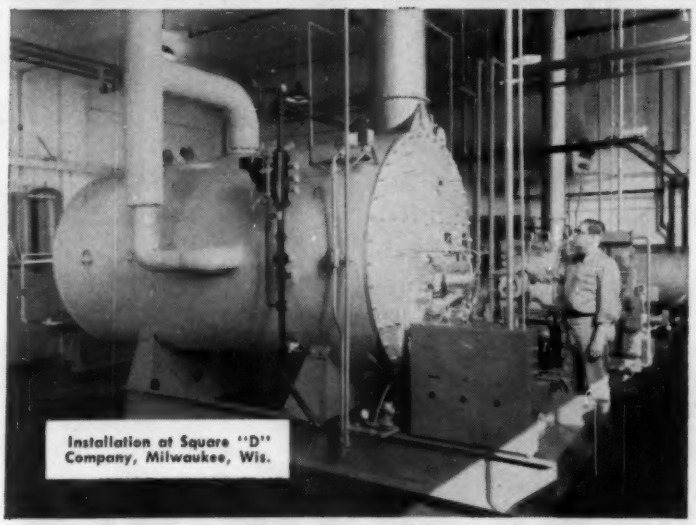

ARCHITECT
• "Self-contained design certainly simplifies boiler room planning — gives owners maximum use from each square foot of space. Gives me flexibility to make best use of low head room conditions."


CONSULTING ENGINEER
• "Oil, gas and combination oil/gas firing lets me recommend Cleaver-Brooks boilers for installation anywhere. Exclusive burner design makes it possible to interchange gas/oil firing in 10 seconds.

CONTRACTOR
• "Boilers are shipped ready to install. With service lines in, my crews have boilers ready for operation in 24 hours or less after delivery. No foundation or stack problems. Cleaver-Brooks furnishes starting service, too."

PLANT SUPERINTENDENT
• "I get all the steam I need for fluctuating steam demands, from full load down to 30% of rating. Automatic burner controls assure instant firing. I call that *real* dependability."


OPERATING ENGINEER
• "Cleaver-Brooks boilers sure are simple to maintain. No more smoke, ashes, clinkers or messy boiler-room conditions. What's more, I get performance I can count on — backed by factory and on-job tests."


Installation at Square "D" Company, Milwaukee, Wis.

THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. B, 311 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

Cleaver Brooks

"It's NEW — get the facts on the CB boiler — write today!"

BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.

NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.

For more data circle 512 on Post Card

Choice for

WA-Series

STEAM TURBINE GENERATOR UNITS

COMPLETE POWER PLANT at Tuscola includes three boilers and two WA-Series steam turbine generator units, shown above. Allis-Chalmers also supplied condensers and condensate pumps for the plant.

ALLIS-

New $44,000,000 Petro-chemical Plant

Two units generate power as by-product from steam required for processing natural gas

NATIONAL PETRO-CHEMICAL CORPORATION'S new Tuscola, Illinois, plant takes up to 425 million cubic feet of natural gas from the adjacent Panhandle Eastern pipeline, extracts 10 million cubic feet of ethane for cracking into valuable industrial chemicals, and returns the gas to the pipeline for transportation to big city customers.

To synthesize this huge amount of ethane into ethylene, hydrogen, and later into other useful components, fractionation and low temperature separation are used. The processes require 600,000 pounds per hour of steam, which is produced at 625 psig, 750 F.

Two condensing, automatic extraction WA-Series steam turbine generators are utilized to produce 10,000 kw of power from the steam before it is delivered into plant processes. The steam is delivered directly into the high temperature side of the automatic extraction impulse turbines, from which it is extracted at 65 psig for use in the plant. Each turbine generator unit is equipped with a housing-type, air-cooled generator and exciter. The entire units are carefully engineered and manufactured to operate as integrated units, 24 hours a day, 7 days a week.

WA-Series steam turbine generator units match the most modern plant design to provide high efficiency power or process steam. They are available in condensing or non-condensing types in NEMA ratings 2000 kw and larger. Bulletin 03B7654 gives complete facts. For your copy just call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4477

OUTBOARD END of one unit shows exciter housing.

Simplified Installation and Maintenance

Every detail of WA-Series steam turbine generator units is designed for maximum simplicity and maintenance. Three-bearing construction, above-the-floor oil piping, and bracket-bearing, housing-type air-cooled generator are some of the features that result in a compact unit with simplified installation requirements. Turbine and generator are shipped with their rotors locked in place, further minimizing installation time.

Maximum reliability is assured by labyrinth spring-back steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and a time-proved governing system.

A-C CHALMERS

A-C ALLIS-CHALMERS

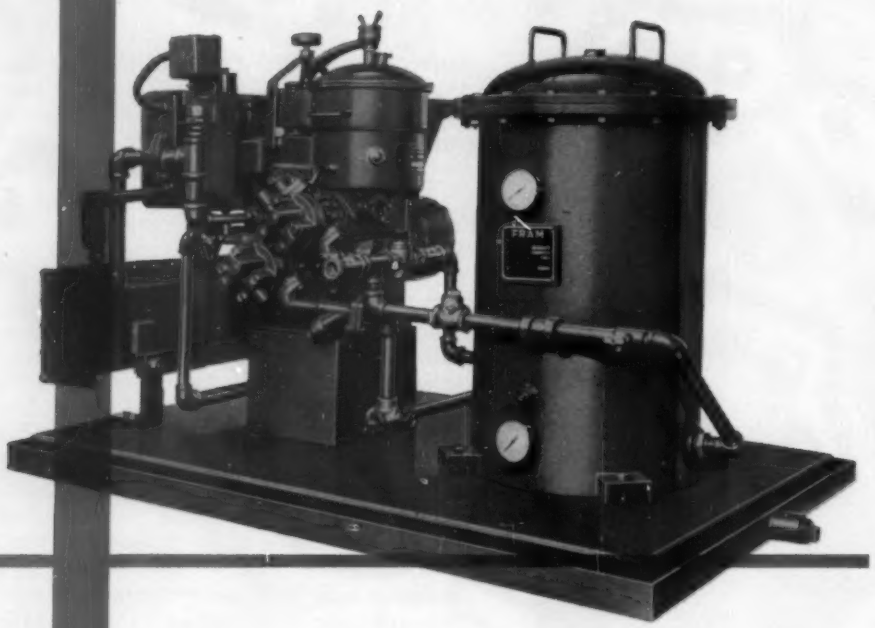
For more data circle 513 on Post Card

Water?

Solids?

Colloidal Carbon?

THE DE LAVAL "PURI-FILTER" GETS THEM ALL!



The De Laval "Puri-Filter" is designed to remove *every* trouble-making impurity from diesel lubricating oil.

By *centrifugal* action, it takes out solid contaminants, including gum-forming solids and the water. It *filters* out colloidal carbon and other minute impurities down to *one micron* (0.000039 in.) in size.

In short, the De Laval "Puri-Filter" does a *complete* job of keeping diesel lube oil clean and dry . . . does it dependably, 24 hours a day, month after month. Investigate . . . today!

DE LAVAL
lubricating oil purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • **DE LAVAL PACIFIC CO.** 61 Beale St., San Francisco 5

For more data circle 514 on Post Card

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

POWELL VALVES THE COMPLETE QUALITY LINE

FIG. 1503—W.E. 150-Pound Cast Steel Gate Valve

FIG. 19084—900-Pound Pressure Seal Non-Return Globe Valve, Gear Operated

FIG. 3031—W.E. Cast Steel Globe Valve for 300 Pounds W.S.P.

FIG. 11365—Cast Steel Pressure Seal Horizontal Lift Check Valve for 1500 Pounds W.S.P.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

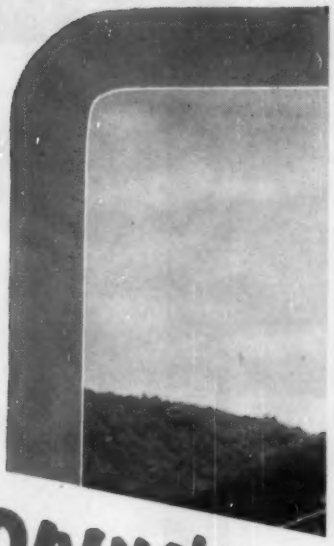
Investigate the many outstanding features of the High Pressure Boiler Non-Return Valve shown above (Fig. 19084). And be sure to find out about the *complete* line of Powell Valves —*quality* valves that will give you dependable flow control.

The valves shown above are examples of the many types of precision-built valves that carry the Powell name and measure up to the Powell standards of quality.

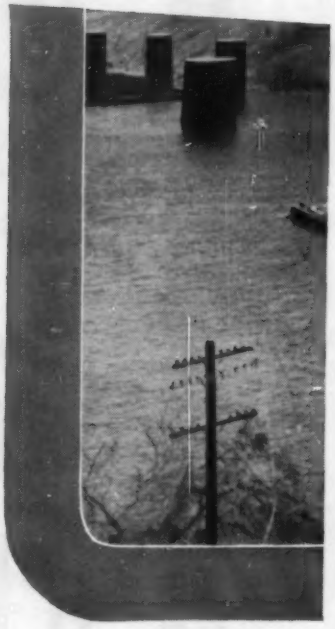
Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write . . .

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year

For more data circle 515 on Post Card



Pacing the nation's power



10 BEST ANNUAL HEAT RATES

(Plant Net Heat Rates)
Btu per kwhr*

9170 KANAWHA
Appalachian Electric Power Co. on the American Gas and Electric System—
Two B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

9329 TANNERS CREEK
Indiana and Michigan Electric Co. on the American Gas and Electric System—
Three B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

9418 ALBANY
Niagara Mohawk Power Corporation.

9454 SCHILLER
Public Service Co. of New Hampshire—
Two B&W-built Mercury Boilers.

9510 DUNKIRK
Niagara Mohawk Power Corporation.

9540 J. R. WHITING
Consumers Power—
Three B&W Radiant Reheat Boilers.

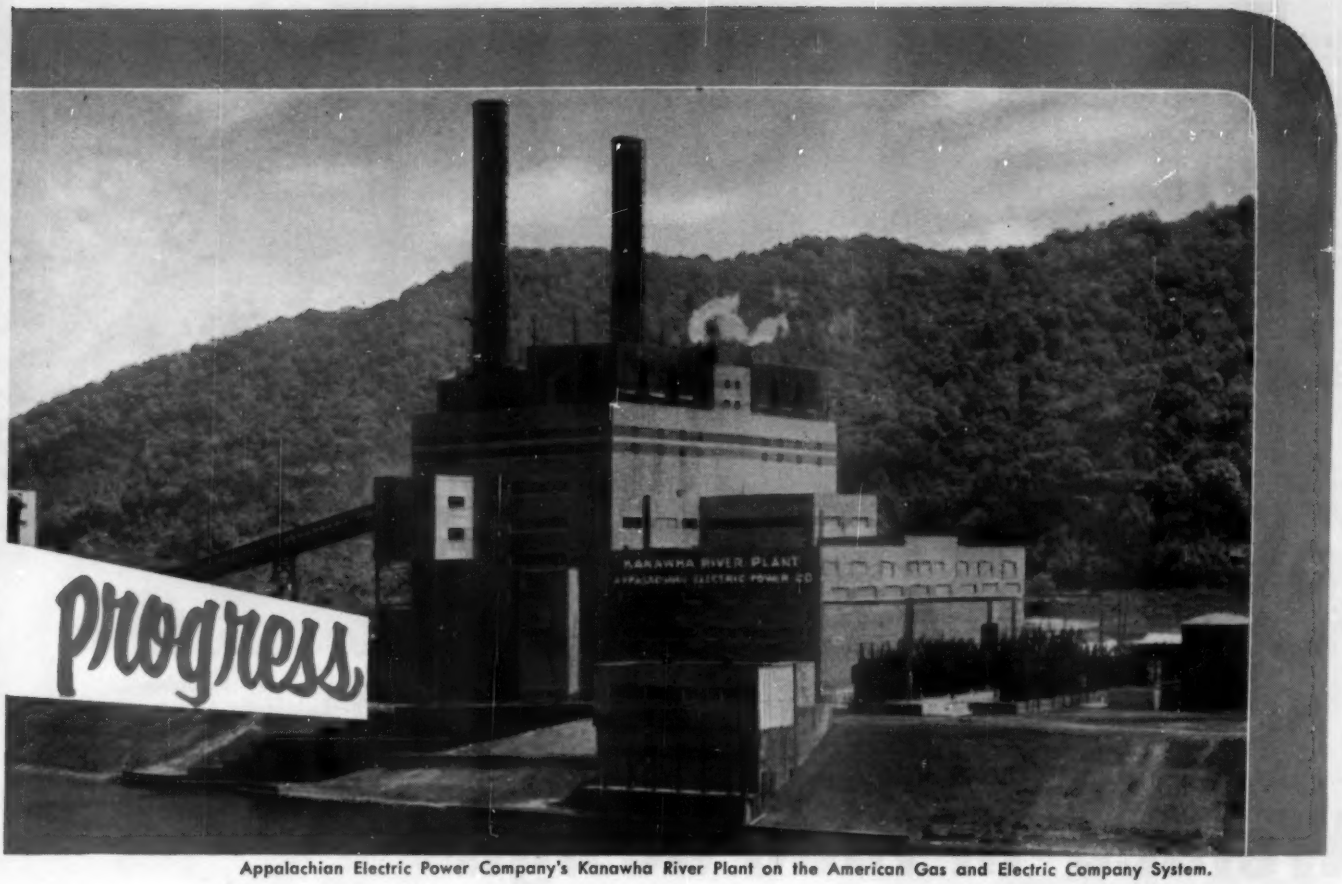
9594 PHILIP SPORN
Appalachian Electric Power Co. and The Ohio Power Co. on the American Gas and Electric System—
Four B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

9630 ST. CLAIR
Detroit Edison Co.—
Four B&W Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

9661 EASTLAKE
The Cleveland Electric Illuminating Co.

9815 ASTORIA
Consolidated Edison Co. of New York, Inc.—
Two B&W Pressure-Fired Radiant Reheat Boilers with Gas Recirculation and Divided Furnace Construction.

* Federal Power Commission figures



Appalachian Electric Power Company's Kanawha River Plant on the American Gas and Electric Company System.

Headed by a record 9170 Btu per net kwhr, these ten plants were the most efficient central stations in the country during 1953, the most recent year for which complete heat rate data are available.

Reflecting the decision of the electric companies to utilize the most recent engineering advances, even during a time of critical capacity expansion, the outstanding performance of these modern plants is a tribute to the foresight of the whole industry. It affords one more indication that the prime interest of this unique team of electric companies and their major suppliers lies in producing still lower-cost kilowatts for a still greater America.

B&W Boilers in many of these stations are designed with such advances as Pressure-Firing, Cyclone Steam Separators, Gas Recirculation and Divided Furnace Construction — features which have contributed substantially toward the outstanding efficiency levels achieved. Also, all steam generating units are equipped with reheaters, a development of major importance in improving plant efficiency.

Pressure-Firing

Among the many advantages of this important engineering advance, as utilized, for example, by the Kanawha River units, is elimination of air infiltration to reduce stack loss and assure greater efficiency. Maintenance is reduced and the use of forced-draft fans alone means easier starting, smoother operation and simpler controls. These are the reasons why more than 100 Pressure-Fired B&W units are now in service or under construction.

Cyclone Steam Separators

Operating inside the steam drum, these simple, stationary devices require no power or maintenance and do not take up building room. The Cyclone Separators assure positive natural circulation at high pressure, and with the steam scrubbers, make it possible to send steam of highest purity to the turbine. Consequently, turbine efficiency is maintained and turbine outages reduced.

Divided Furnace Construction

With this B&W construction, building volume is held to a minimum. Both sides of the furnace division wall are used to absorb heat and thus make it possible to achieve the required furnace cooling surface without excessive increase in building volume.

* * * * * *

The record heat rates set by these leading generating stations are closely followed by those of many more plants across the country which are producing low-cost kilowatts at efficiency levels unattainable just a few years ago. And B&W is continuing to devote its energies and its long-accumulated experience to the development of boiler designs that will contribute to still higher levels of steam generating efficiency. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-696

For more data circle 516 on Post Card

A new technique. Using a 140 Monel electrode, welder joins tube ends to tube sheet by manual metal arc process. Monel-tubed high pressure heat exchangers constructed by this method give many years of trouble-free service. *Photo courtesy of The Lummus Company, New York.*

Welded-in tube design

minimizes maintenance in high pressure heaters

Today's technique of rolling feed-water heater tubes tightly into the tube sheet may soon be out-moded.

Using a method pioneered by Burns and Roe, Inc., New York consultants, The Lummus Company now builds exchangers with Monel® tubes *welded* in.

A primary advantage of the new method is that it has reduced the possibility of leaks at the tube sheet to a remarkable degree. One Mid-West municipal power plant, for example, has four of these welded Monel-tubed high pressure heaters. Two of them have been in service since 1946. None has given any trouble.

Of course, the success of the welded-in technique depends in large measure upon the tube material. It must join the tube sheet in a strong, sound weld. It must have high strength . . . good heat transfer properties . . . excellent resistance to corrosion.

Monel tubes qualify on every count. They are readily weldable, and fuse well with steel. Their high mechanical properties permit use of lighter gauges as a means of improving heat transfer. Their excellent resistance to corrosion extends exchanger life . . . reduces failures . . . cuts downtime.

And here's another desirable feature of Monel tubes — *in certain sizes they can now be drawn up to 85 feet in length.* Designers, therefore, can take advantage of longer tube bundles, and effect worthwhile economies by specifying heaters of *smaller* diameter.

Consider Monel the next time you design, install or re-tube a high pressure heater. Get full information now so you'll have it handy when the time comes. Write today for a free copy of our bulletin "Engineering Properties of Monel."

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

More POWER for you... with MONEL INCO TRADE MARK **NICKEL ALLOYS**

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HELPFUL BULLETINS

ELECTRICAL EQUIPMENT

101 Improved D-C Motors — Described and pictured in 12-pp Bulletin C-2002 is a new line of d-c motors announced as producing the fastest and most accurate response offered in a standard design motor. Gives examples of this dynamic response and provides curves showing speed ranges, ability to accelerate etc. Discusses component parts of these motors — armature, frame, brush rigging, winding and insulation. Provides dimensions for estimating and selection data. Reliance Electric and Engineering Co.

102 Permanent Magnet D-C Motors — Catalog F 4344-1, 22-pp, describes permanent magnet direct current motors with outputs to $\frac{1}{10}$ hp, contains data sheets on typical motors from 6 v to 115 v d-c. Units having radio noise filters, gear heads, and centrifugal blowers are described, and specifications are included. Schematic drawings are used throughout to illustrate the various motors. Barber-Colman Co.

103 Armored Motors — This 20-pp illustrated publication, designated GEA-4654C, describes company's armored motors, direct current types. Bulletin provides information on performance and maintenance features of the heavy-duty motors, including horsepower ratings and mechanical data. Diagrams and photos illustrate various applications of armored motors. General Electric Co.

104 Heavy Duty FHP Motors — Features and performance characteristics of unidirectional motors in ratings up of $\frac{1}{20}$ hp are presented in Bulletin F 3959-2. Specifications, dimensions and performance curves provided. Barber-Colman Co.

105 Distribution Transformers — Bulletin GEA-6126, 24-pp, describes design features of company's self-protected pole-type distribution transformers rated 100 kva and below. Gives detailed information for urban and suburban applications, explaining how internal circuit breaker design allows full use of transformer capacity and gives good overcurrent protection; and how gapped valve-type arresters provide better protection and can be used anywhere on the system regardless of short-circuit currents. Exterior, interior, and cutaway assembly pictures outline design features and advantages, and charts give prices, data, and dimensions of standard type transformers. General Electric Co.

106 Power Distribution Systems — Twelve-pp Bulletin PFC-104 describes capacitors in steel and stainless steel cases for primary and secondary power distribution circuits and industrial circuit applications. Bulletin also summarizes economy advantages of capacitors in power systems, construction, processing details; and test specifications. Tobe Deutschmann Corp.

107 Control of Voltage Output — Bulletin T-8300 describes a new type all static voltage regulator for 60 cycle a-c alternators. Brochure gives detailed information on construction, operation, installation, describes various models, and includes specifications. A list of suggested uses is given. Inet Div., Leach Corp.

108 Enclosed Fuse Cutouts — Illustrated Bulletin GEA-6208, 20-pp, describes company's line of enclosed fuse cutouts, covering design features, application information, technical data, dimensions and ratings. Explains how flexibility is accomplished with one housing and four interchangeable doors in each voltage and current rating. General Electric Co.

109 Electrometers for Industry — This 12-pp bulletin describes company's line of electrometers, discussing chief characteristics and advantages. Various models and types of meters are fully described and specifications and application data are included. Keithley Instruments.

COMMUNICATIONS

110 Communications Dictionary — Words and definitions peculiar to microwave and mobile radio communications are compiled in this 40-pp glossary. Utilizes sketches, diagrams, and charts, as well as text, to define esoteric terms which describe theory, nature, and operation of radio communications equipment. Glossary ranges from "absorption coefficient" to "zero-bias," lists technical and non-technical organizations, and supplies abbreviations of most widely used technical terms. Engineering Products Div., Radio Corp. of America.

111 Two-Way Radio — This illustrated 12-pp bulletin shows what two-way radio is, how it works, and what it does. Applications in various industries are detailed and illustrated, and one section is directed to special industrial and low-power industrial services. Bulletin explains FCC controls of available channels and tells how the Frequency Allocation Committees work. Radio equipment for industrial use is described in detail and typical installations illustrated. Also explains means for procuring a two-way radio system, giving the various steps of planning, installing, operating. Engineering Products Div., Radio Corp. of America.

INSTRUMENTS AND CONTROLS

112 Remote Transmission Systems — This 8-pp catalog introduces company's remote transmission systems for water, sewage and process plant uses, Autocon Telestep. Defines telemetering, types of telemetering equipment and describes advantages and benefits available with Telestep. Catalog reviews five Telestep models; 1-step, 2-step, 2-step with reporting signal, multiple step (bridge type), and proportional-multiple step. Basic Autocon pressure, float and probe sensors are discussed. Automatic Control Co.

113 Meters for Industrial Liquids — Bulletin 567, 8-pp, presents full details on company's industrial liquid meters. Included are various quantity control meters, models providing printed tickets for each delivery or batch, and those with simple direct reading registers. Includes chart for selecting proper size and type of meter for any given application. A list of 150 common chemicals and liquid ingredients now being used successfully with the meters is included. Neptune Meter Co.

114 Electric Proportioning Control — Sixteen-pp Folder ND4(7a) introduces this company's Series 60 electric proportioning control, available for proportional action control, for position-adjusting type or duration-adjusting type control. Each of these is dealt with in detail, text covering features and application suggestions. Illustrations include photos, dimensional drawings, circuitry diagrams. Leeds & Northrup Co.

115 Electronic Gauger System — Application Data Sheet 102 describes an electronic gauger system widely used in pipeline operations. Illustrates principles of operation, equipment, circuitry, and the use of company's precision potentiometers in this telemetering system. Helipot Corp.

The new and revised publications reviewed on these pages offer help on many operating and maintenance problems. To order them, use the Reader Service Cards on pages 115-116

116 pH Recorders and Controls — Complete systems for pH recording and control, which incorporate the Beckman Model W amplifier, are described in profusely illustrated Bulletin Q 1304, 38 pp. Describes an electronic Dynamaster Potentiometer recorder or controller, an amplifier, electrode assemblies in either flow or immersion types, and final control elements for the addition of gaseous, liquid, solid, or slurried reagents. Full engineering specifications and illustrations of each component of the systems are given, and methods of installing instruments in a number of applications are described. The Bristol Co.

117 Pneumatic Transmitter — Technical Bulletin 285-L2 describes company's BalanCel pneumatic transmitter for measuring flow, level, and differential pressures in water filtration and sewage plants, and for low pressure industrial service. Contains photos, installation diagrams, and dimensional drawings illustrating the advantages, uses, and operation of this compact transmitter, which operates on the force-balance principle. Builders-Providence, Inc.

118 Graphic Instruments — Sixteen-pp Condensed Catalog 854 presents company's line of electrodynamometer and permanent-magnet moving-coil recorders and other instruments, including operation recorders, pressure and vacuum recorders, contact-making instruments. Also describes chart drives, instrument cases, accessories and supplies. Booklet is generously illustrated with photos of

instruments and installations; includes suggestions for their use. The Esterline-Angus Co., Inc.

119 Detector Systems — This 8-pp brochure describes a new approach to simplifying maintenance of complex electrical controls — wired-in checking systems consisting of separate electrical circuits wired to schematic electrical diagrams. Covers general design and operating principles of the Electro-Graphic Detector and tells how systems may be tailored to fit a wide variety of mass production applications. Also includes illustrations showing design details of the individual detector panels. W. F. & John Barnes Co.

120 Smoke, Combustion Instruments — Bulletin 532, 8 pp, discusses use of photoelectric instruments for detection and control of smoke and haze, and the use of indicators and controls for monitoring or controlling fuel-air ratio for best efficiency. Two types of recorders for smoke or combustion haze densities are presented. Ess Instrument Co.

MECHANICAL POWER TRANSMISSION

121 Split Ball Bearings — Catalog 54, 24 pp, describes company's line of split ball bearings. Load and speed ratings are given, as well as design data and dimensions. Describes single and double row ball bearing bushings, in extra thin section; fully split heavy duty pillow blocks; fully split heavy duty ball and roller bearings; thin section instrument bearings in torque tube dimensions for precision applications, others. Split Ballbearing Corp.

122 Malleable Couplings — This 16-pp illustrated folder describes company's line of malleable pipe couplings and fittings. Thirty photos demonstrate savings in time and labor made by Rolagrip couplings for plain end pipe and Gruvagrip and Gruvajoint couplings for grooved pipe. Diagrams and specifications are included. Gustin-Bacon Mfg. Co.

123 Fluid Couplings — Bulletin 144-D, 14-pp, presents complete installation and performance data on fluid couplings. Illustrated with diagrams and drawings, the bulletin shows ease of applying company's fluid couplings on any type industrial equipment, powered by any type electric motor or internal combustion engine from ¾ to 850 hp. Describes standard models providing standard input, output combinations, and standard models in packaged units. Installation hook-ups are given, along with typical on-the-job applications. Twin Disc Clutch Co.

HEATERS, HEATING

124 Console Heaters — Bulletin 727 introduces a line of console heaters featuring new styling and a wide range of colors. Gives dimensional and mounting data on top and front discharge models for floor, wall and ceiling mounting. Also includes performance information. American Air Filter Co., Inc.

125 Underfloor Heating System — Installation details and specifications for Ceramiduct, a clay product for perimeter and radial underfloor slab heating duct systems, are included in this illustrated bulletin. Emphasizes such advantages as economy, and resistivity to thermal shock, rust, corrosion. Straitsville Brick Co.

. . . Outstanding Among This Month's Catalogs

126 Lighting and Distribution Panelboards — Bulletin 501, 24-pp, describes company's line of lighting and distribution panelboards for industrial and commercial use. Federal specifications are given as they relate to the circuit breaker and fusible type panelboards. All panelboards are illustrated, and construction design and application features are given, as well as ratings, weights, dimensions, and knockout arrangements. The bulletin also includes typical specifications and standard and special panelboard housings. Continental Electric Equipment Co.

127 Manual on Insulated Cables — Bulletin OK-1085, 128 pp, provides complete data on Okolite-Okoprene 0- to 5000-v unshielded, rubber-insulated Neoprene-sheathed cable. As this cable is commonly used by industrial and utility plants for low voltage power and control circuits, the current carrying capacity tables, short circuit curves, voltage regulation formulas and methods for determining conduit sizes, pulling tension and bending radii should prove extremely useful. Also included is discussion on advantages of cables not requiring shielding for 4160-v operation. Book is available to qualified power engineers. The Okonite Co.

128 Industrial Fan Catalog — Of interest to power engineers requiring quick, accurate selection of industrial fans for specified capacities, 28-pp Bulletin EX-531 contains selection tables from which correct fan for required capacity can be determined. Complete descriptive information, detailed capacity tables and dimensional data are also included. In addition, catalog describes a new industrial fan offering improved efficiency, wider size range. Bayley Blower Co.

PUMPS, COMPRESSORS

129 Seal-less Centrifugal Pumps — The design and development of centrifugal pumps without seals or stuffing boxes is described in this 12-pp technical paper. Covers design history, early experimental work and outlines the basic problem of building an electric motor inside a pump. Included are detailed data and curves regarding temperature, pressure, and the effects of the unusual pump design on electric motor operation. New developments in the canned rotor pump field are discussed, and operational case histories given. Chempump Corp.

130 Vertical Multi-Stage Pumps — This 12-pp bulletin, Form 7096, describes company's vertical multi-stage pumps, giving sectional drawings, dimensions and installation views of the pumps in service. Discusses installation, operation and maintenance problems and lists specific features which assure dependable operation. A number of different classes of pumps for various applications are treated. Ingersoll-Rand Co.

131 Proportioning Pumps — Controlled capacity pumps and liquid proportioning equipment in standard and low pressure types are presented in 16-pp Bulletin S-1254. Illustrates and gives features for standard simplex and duplex pumps, single-revolution clutch-operated models, a low cost, low pressure pump. Also discusses capacity control mechanisms. General specifications, selection and application charts and ordering tips are also provided. Philadelphia Pump and Machinery Co., Inc.

132 Jet Syphons — Bulletin 2A, 24-pp, treats the application, operation, construction and performance of jet syphons which utilize the pressure energy of steam or air to pump, heat and mix liquids, gases and slurries. Included are 17 tables on suction capacities, steam consumption, operation pressures, and sizes and dimensions. Applications described include intermittent pumping of liquids from tanks and pits, supplying heated water to jackets of stills and graining bowls, mixing of ammonia and other gases, and other uses. Schutte and Koerting Co.

133 Automatic Blender — This 8-pp bulletin describes company's two component blender, designed to provide a complete equipment "package" for "on stream" blending. Lists advantages of the blender and describes its application in caustic dilution, asphalt blending, cutting of heavy fuel oil and blending of butane and gasoline. Illustrates operation. Proportioneers, Inc.

134 What's New in Compressors — "Recent Advances in Engine and Compressor Design," is an illustrated article telling how higher power output has been achieved with lower fuel consumption and lessened cooling requirements. It also describes a new type of turbocharger and a new engine particularly designed for turbocharging. Included in this 10-pp booklet is another article covering operating economy achieved by a turbocharged compressor installed on a gas transmission pipeline. Clark Bros. Co.

LUBRICATION

136 Lubricant Powder — Featured in Bulletin 104 is Molykote Microsize powder for application to bearing surfaces by tumbling, burnishing, dusting or rubber, or for use as an additive to liquids and greases. Bulletin provides data on relative particle sizes of molybdenum disulfide powders in relation to their ability to penetrate crevices of ground bearing surfaces. The Alpha Corp.

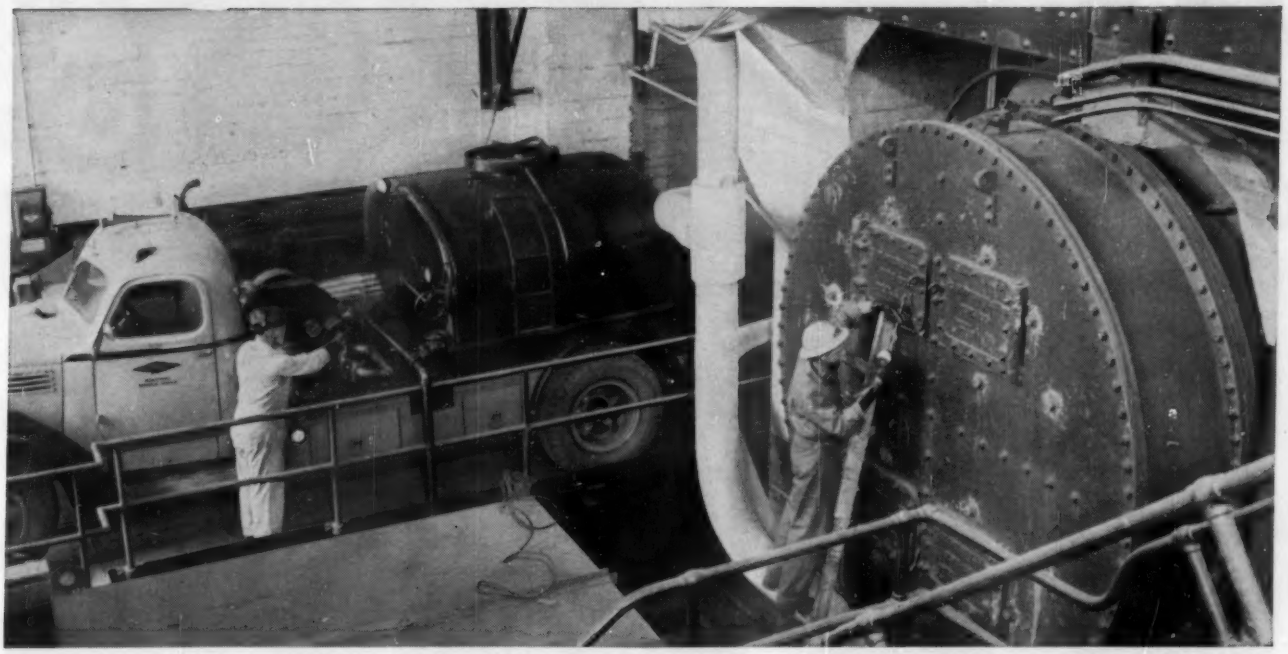
137 Fringe Area Lubrication — Bulletin 103 lists all types of molybdenum disulfide lubricants and describes new concepts of extreme pressure or boundary lubrication in which solid lubricants perform a major function. Explains participation of the lubricants in this fringe area lubrication field. Eleven types of Molykote are listed and described according to ingredients, working temperatures, and method of application. Discusses ten industrial applications. The Alpha Corp.

VALVES, TRAPS, PIPING

138 Unions, Check Valves — Illustrated Catalog 55, 24 pp, describes and provides ordering information on a line of forged steel unions and check valves. Socket-weld, high-speed, orifice, O-ring and other unions are included. Catalog provides service recommendations, dimensions and list prices. Also included is table showing discharge of water to atmosphere for circular straight edge orifices. Clayton Mark & Co.

CHEMICAL CLEANING SAVED 400 TONS OF COAL PER YEAR

Fly ash, soot and carbonate deposits removed from condenser by Dowell; vacuum increased



Fly ash and carbonate deposits on the water side of an 800-KW turbo surface condenser had reduced vacuum from a normal 28″ to 24″. The temperature of the water leaving the condenser had dropped from 95°F. to 85°F.

These deposits were removed by Dowell Service with specially prepared liquid solvents. Result: the condenser was restored to its normal operating efficiency. The steam requirement was reduced by 2.5 pounds per kilowatt hour. On the basis of 8,000 hours of yearly operation, the plant engineer calculated a saving of at least 400 tons of coal per year.

Dowell chemical cleaning methods can be used on hundreds of different kinds of industrial equipment. Engineers especially trained for this kind of work do the job for you. They apply solvents according to the technique demanded by the job: filling, spraying, jetting, cascading or vaporizing. Dowell liquid solvents can go wherever steam or water will flow, reaching places inaccessible to other cleaning methods. Scaffolding is unnecessary. Dismantling and downtime are kept to a minimum.

A call for Dowell Service will bring experienced personnel to your plant within a few hours with all necessary chemicals, pump trucks and control equipment. For complete information and estimates on the cleaning of your equipment, contact the nearest Dowell office, or write directly to Tulsa, Dept. B-24.

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Over 100 Offices to Serve You with Chemical Cleaning for:

Boilers • Condensers • Heat Exchangers • Cooling Systems
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Process Equipment • Evaporators • Filter Beds • Tanks

Chemical Services for Oil, Gas and Water Wells

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DOWELL

A Service Subsidiary of
THE DOW CHEMICAL COMPANY

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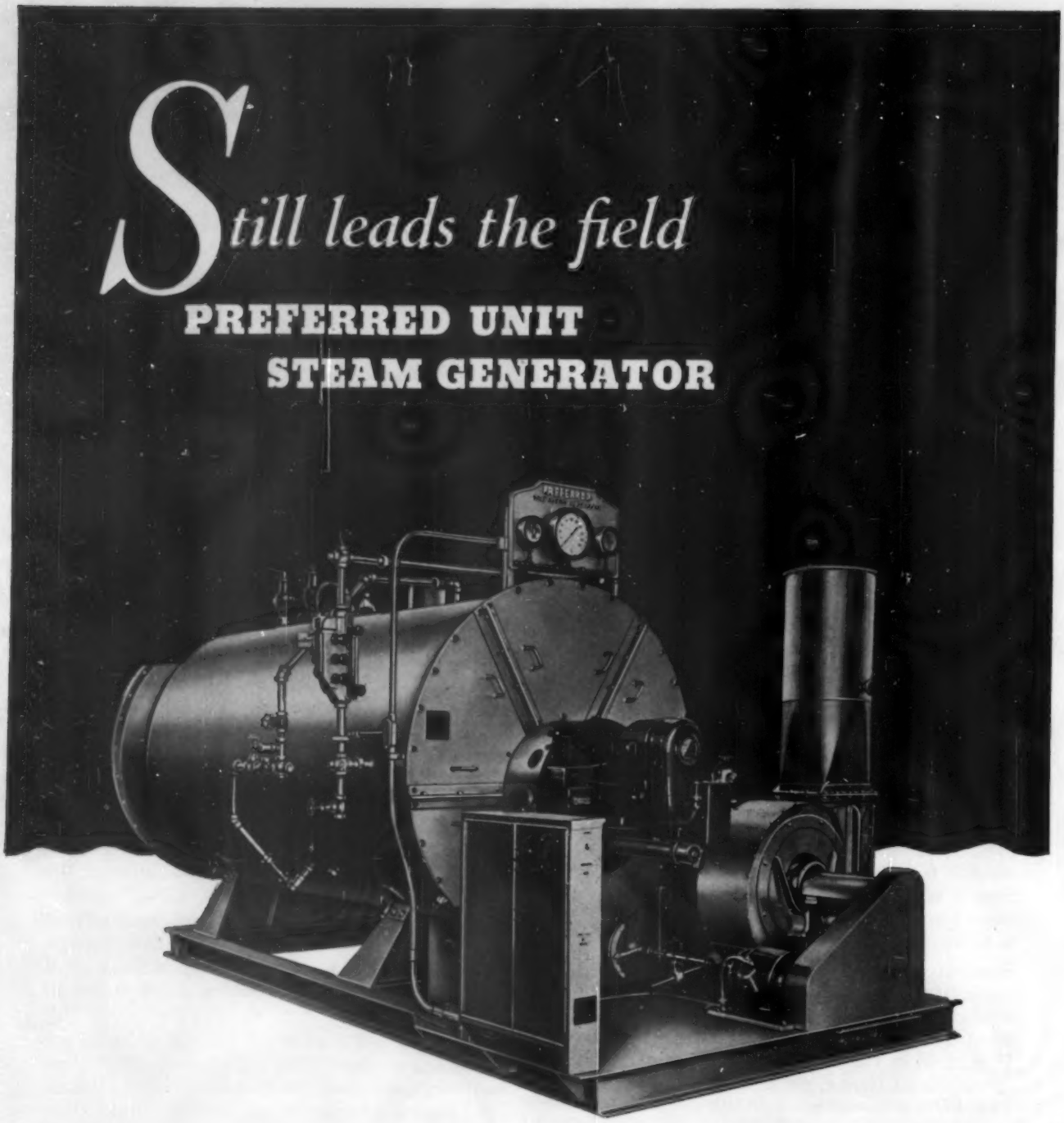
Still leads the field

PREFERRED UNIT STEAM GENERATOR



Preferred Unit Steam Generators are built in sizes from 20 to 600 BHP, pressures 15 to 250 p.s.i. Burn oil, gas or in combination. ***Every Preferred Unit Steam Generator is factory fire-tested before shipment.***

IT'S A FACT—the finest unit steam generator costs the least over its entire life span. That's why Preferred has never lowered the quality of its product to lower the first cost. This accent on progressive engineering not only insures Preferred's leadership in its field, but also gives you—the buyer—true boiler economy.

Such Preferred design features as four-pass gas travel, staggered tubes, anti-stress deck, induced draft and expansile precipitator assure a minimum of 25 years of maximum operating efficiency. These factors make for dependable, automatic boiler performance that pays for the investment in a relatively short time through savings in fuel, operating and maintenance costs.

Bulletin 2000 tells the whole story. Write for it.

PREFERRED UTILITIES MANUFACTURING CORP.

1860 BROADWAY, NEW YORK 23, N. Y.

Department PE-6

For more data circle 519 on Post Card

139 Stainless Steel Valves and Fittings — This 8-pp bulletin is designed to clarify procedures for specifying stainless steel valves and fittings in the pulp and paper industry. In addition to discussions on applications, processes, methods of installation and maintenance, the booklet includes diagrammatic illustrations and tables on mechanical properties, physical properties and corrosion resistance. Cooper Alloy Corp.

140 Butterfly Valves — This bulletin contains information on company's butterfly valves, listing advantages, sizes, pressures, and velocities, and giving data on operators and positioners. Shows general arrangement dimension prints of various size valves with manual, electric, hydraulic, and pneumatic operators. In addition, it contains photos and detailed descriptions of each valve component. Builders-Providence, Inc.

141 For Power, Process Work — This well-illustrated 16-pp booklet describes Paul Venturi-Ball valves designed for straight through non-turbulent flow, smooth throttling, easy opening and closing, and tight shut-off. Bar stock valves, control valves, digester valves, and special valves are presented. Booklet also explains design principle of the valves, covers methods of operation and lists typical installations in power plants, processing industries and pulp and paper mills. P-K Industries, Inc.

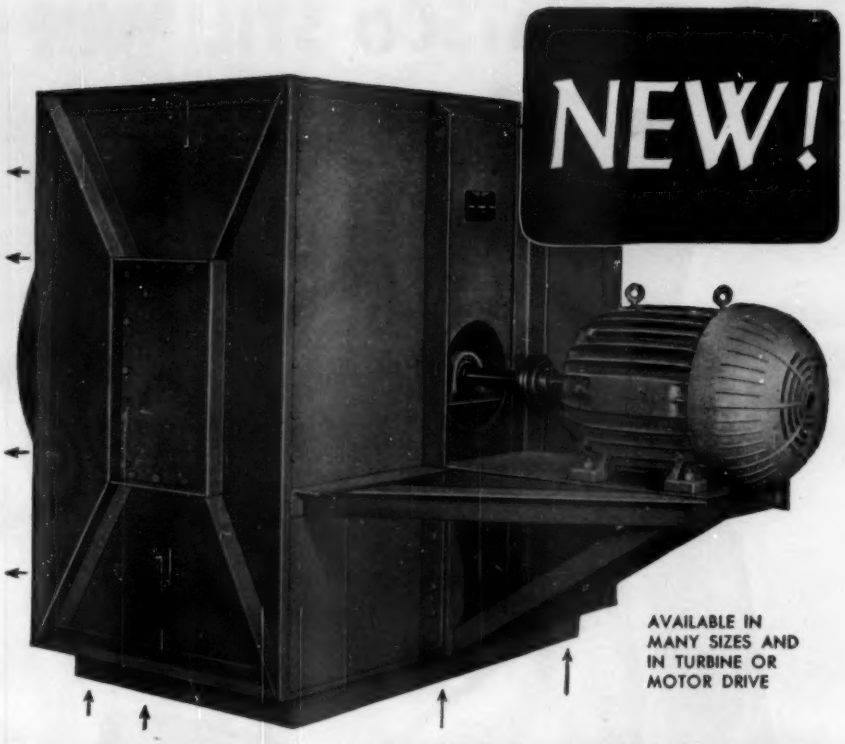
142 PVC Valves, Fittings — Circular 601 describes Luncor all-molded polyvinyl chloride valves and fittings. Stresses corrosion resistance of these valves, lists some industrial fluids they handle. A large cutaway illustration shows design details of the valve. Also included are dimensions for valves and pipe fittings. The Lunkenheimer Co.

143 Industrial Valves — Condensed Catalog 105, 28-pp, contains data on valves for a wide variety of applications. Includes dimensions and illustrations describing non-return (stop-check) valves, globe and angle stop valves, pressure seal design, angle univalves and small size globe valves designed for chain or extension operation in vertical lines. Also included is company's Mudwonder valve for abrasive fluid application in industry as well as mudlines in the oil field. Edward Valves, Inc.

Postage-free cards for ordering catalogs are on pages 115–116. You may also use the cards to ask for further information on the advertised products.

144 Corrosion-Resistant Valves — Eight-pp Bulletin 8 describes Aloyco 20 corrosion-resistant valves, incorporating recent field-test data on the valves in various concentrations of sulfuric acid at different temperatures. Also includes a description, applications, and advantages of this austenitic alloy, together with engineering specifications and cross-sectional illustrations of 39 valves and fittings. Alloy Steel Products Co., Inc.

145 Improved Coal Valve — Eight-pp Form 97 presents an improved coal valve designed to give long service and



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FOR POWER PLANTS

MOTOR AND FAN DESIGNED AS ONE COMPLETE REMOVABLE UNIT

MAKES INSTALLATION EASIER

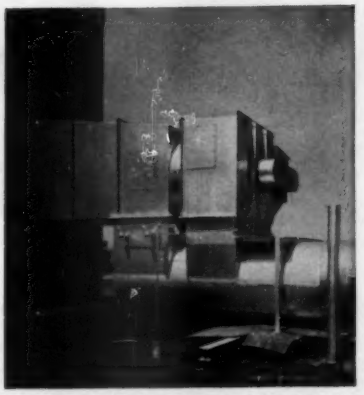
FACILITATES INSPECTION AND MAINTENANCE

SAVES SPACE

ELIMINATES WATER COOLING OF BEARINGS

INTERCHANGEABLE INLETS—TOP, BOTTOM OR SIDES

NO LUBRICATION REQUIRED—BEARINGS PRE-SEALED



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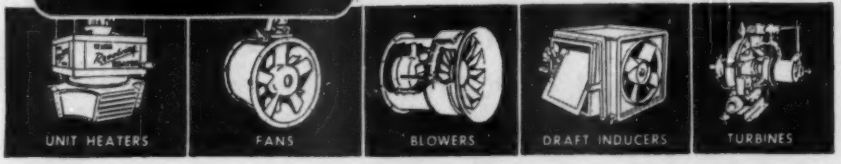

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- COUPLINGS
- REDUCERS
- HALF COUPLINGS

And be 3 Ways SURE

...THAT THE MATERIAL IS RIGHT—all W-S steel couplings and reducers are in accordance with ASTM Specification A-105—Grade 2.

...THAT THE MACHINING IS RIGHT—threads or sockets are accurately machined—perfectly aligned.

...THAT THE IDENTIFICATION IS RIGHT—recessed figures on outside circumference clearly define the pressure rating and the material — and the unmistakable Double-Diamond trade mark is your assurance of high quality manufacture.

Watson-Stillman Couplings and Reducers in your piping system mean true economy. They give you long, trouble-free service, insure strong, leakproof joints and readily withstand the effects of shock and vibration.

Strengthen your piping system with these Watson-Stillman fittings. Screw-End Type available in 3,000 and 6,000 lb. class, sizes ⅛" to 6". Socket-Welding Fittings for schedule 40, 80, 160 and Double-Extra Heavy pipe in sizes ⅛" to 6".

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HKP **H. K. PORTER COMPANY, INC.**

Roselle, New Jersey

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operate under adverse conditions of dry dusty coal or fine wet coal. Construction features of the valve are described and some installations shown. Dimensions are included, also information on accessories available for special operating conditions. Stock Equipment Co.

146 Heating System Traps — Forged bronze steam traps for low and high pressure heating systems are described in this bulletin. Shows how trap works in air venting, condensate draining, steam trapping, other functions; also gives engineering and design features. Reduction of water hammer, improved heat transfer, presetting of temperature differential, and other advantages are discussed. Includes dimensions and capacities, installation tips. Velan Engineering Ltd.

147 Protection for Pipes — An aluminum jacketing for insulated lines, towers, vessels and tanks is described in this illustrated folder. Tells how it reduces maintenance, is weather- and corrosion-resistant, easily applied, offers other advantages. Also shows how to apply this covering. Walex Metal Products Co.

WATER TREATING

148 Reboiling Deaerator — Bulletin 3677 outlines advantages of company's reboiling deaerator with direct contact internal vent condenser, which heats and deaerates water in three stages. Describes the three stages and includes an exploded photo illustrating the design and operation of the apparatus. The Permutit Co.

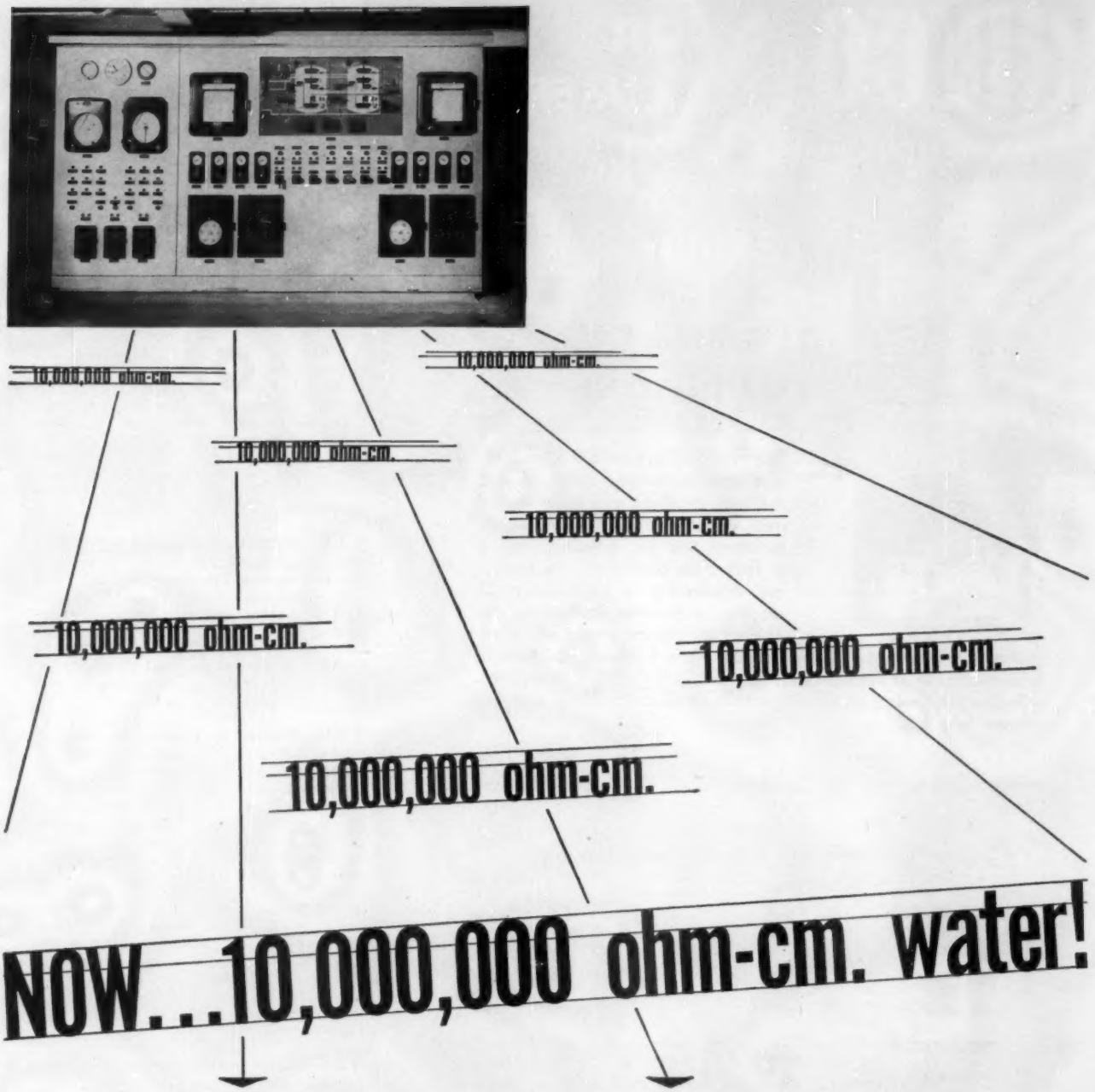
149 Control of Cooling Tower Water — Process Data Sheet 700 (1) offers suggestions on measurement and control of the pH of cooling tower water, and describes equipment for this application. Discusses company's Speedomax control system and its applications and points out various features which assure accurate pH control. Leeds & Northrup Co.

150 Chemical Control and Testing — The need for intelligent chemical control and testing to assure the success of a water conditioning program is described in this 6-pp pocket-sized folder. Emphasizes need for explicit control limits and chemical tests to show that these limits are being met, and proper technical skill required to prescribe these limits. Also shows varying needs for testing equipment by different types and sizes of plants. Hall Laboratories, Inc.

OTHER EQUIPMENT

151 Steam Generator — This manufacturer's new Type D steam generator, a packaged unit for pressure firing with gas, oils or combination of fuels, is described in an 8-pp catalog. Gives complete data and dimensions on this water tube generator which is available in 17 sizes with capacities from 8000 to 40,000 lb of steam per hour. Fully illustrated, booklet explains economical steam production, low installation cost, other advantages. Provides details on controls and combustion equipment which may be selected. Superior Combustion Industries Inc.

152 Crawler Tractor — Features of company's HD-9 diesel-powered crawler tractor are shown in a 3-pp cutaway view which highlights illustrative material in this 30-pp catalog. Tells the engineering, mechanical and operating story of the HD-9, illustrating the tractor's versatility



at 160 gpm for 2050 psig boilers... by Demineralization

Just a few years ago, producing large quantities of water of a purity of 0.01 ppm was quite a chore. A tedious, drawn out multiple distillation technique was required. Engineers "dreamed" of producing this water at large flow rates for high pressure boilers and power plants by an easier and more economical method.

Today, at the Pennsylvania Electric Company, Shawville Station, this has become a reality. Makeup for 2050 psig boilers is produced at a rate of up to 160 gpm and with a purity of 10,000,000 Ohm-cm (0.01 ppm) and **less than 0.02 ppm silica** by a fully automatic Graver Mixed-Bed Demineralizer with in-built dependability.

Write for new Demineralizing Bulletin.

GRAVER

GRAVER WATER CONDITIONING CO.
A Division of Graver Tank & Mfg. Co., Inc.
216 West 14th Street, New York 11, N.Y.

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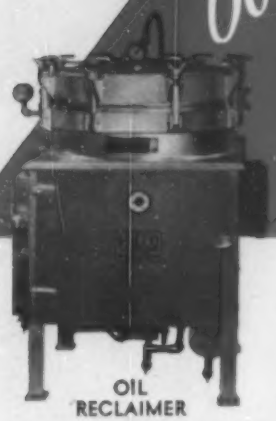
HILCO OIL RECLAIMERS

REMOVE WATER, SLUDGE, ACID

for complete

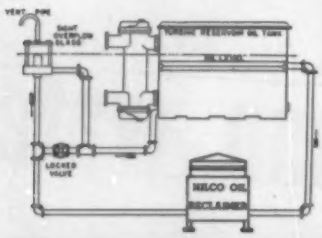
TURBINE OIL CONDITIONING...

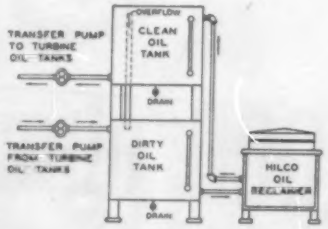


OIL RECLAIMER

The HILCO Turbine Oil Reclaimer is a self-contained, compact unit that will produce and maintain oil free of all solids, sludge, acids, moisture and air, keeping the oil in first class condition. Its purifying process is a continuous, all electric, automatic operation, requiring infrequent attention. It removes contaminants as fast as they are formed, maintaining lubricating oil at full value of new oil. HILCO Oil Reclaimers will also purify compressor, hydraulic, insulating, Diesel and gas engine lube oils.

Purifies Turbine Oil by Continuous or Batch Purification . . .





A continuous, direct-connected, foolproof oil reclaiming system. Oil flows from turbine reservoir tank to sight overflow glass, to HILCO Oil Reclaimer, and back to reservoir.

A batch system designed to serve one or more turbines when it is desired to withdraw all the oil from reservoir for complete periodic batch reclaiming to restore all oil as good as new.

★ WRITE FOR THIS FREE BOOKLET TODAY . . .

FOR MORE INFORMATION ON HILCO TURBINE OIL RECLAIMERS

THE HILLIARD Corporation

162 W. FOURTH STREET ELMIRA, N. Y.

IN CANADA: Upton-Bradeen-James Ltd., 890 Yonge St., Toronto; 3464 Park Ave., Montreal

For more data circle 523 on Post Card

and performance ability with numerous photos. Allied equipment and special accessories are also pictured. Tractor Div., Allis-Chalmers Mfg. Co.

153 Selecting a Blowdown System — A simplified chart for calculating savings possible through heat recovery with a properly sized automatic continuous blowdown system is offered in this pamphlet. Chart is based on total dissolved solids in the boiler water and the permissible concentrations to determine total blowdown. When blowdown quantities are known, selection of heat exchanger and savings can be determined. Henszey Co.

154 White Water Treatment — Savings realized from equipment used in white water treatment are discussed in 8-pp Technical Reprint T-122. The article deals with the methods of white water treatment, types of equipment used and limiting factors in the use of each type. There are detailed illustrations of equipment, a discussion of each type and detailed economic calculations showing costs and savings possible through use of white water treatment. Graver Water Conditioning Co.

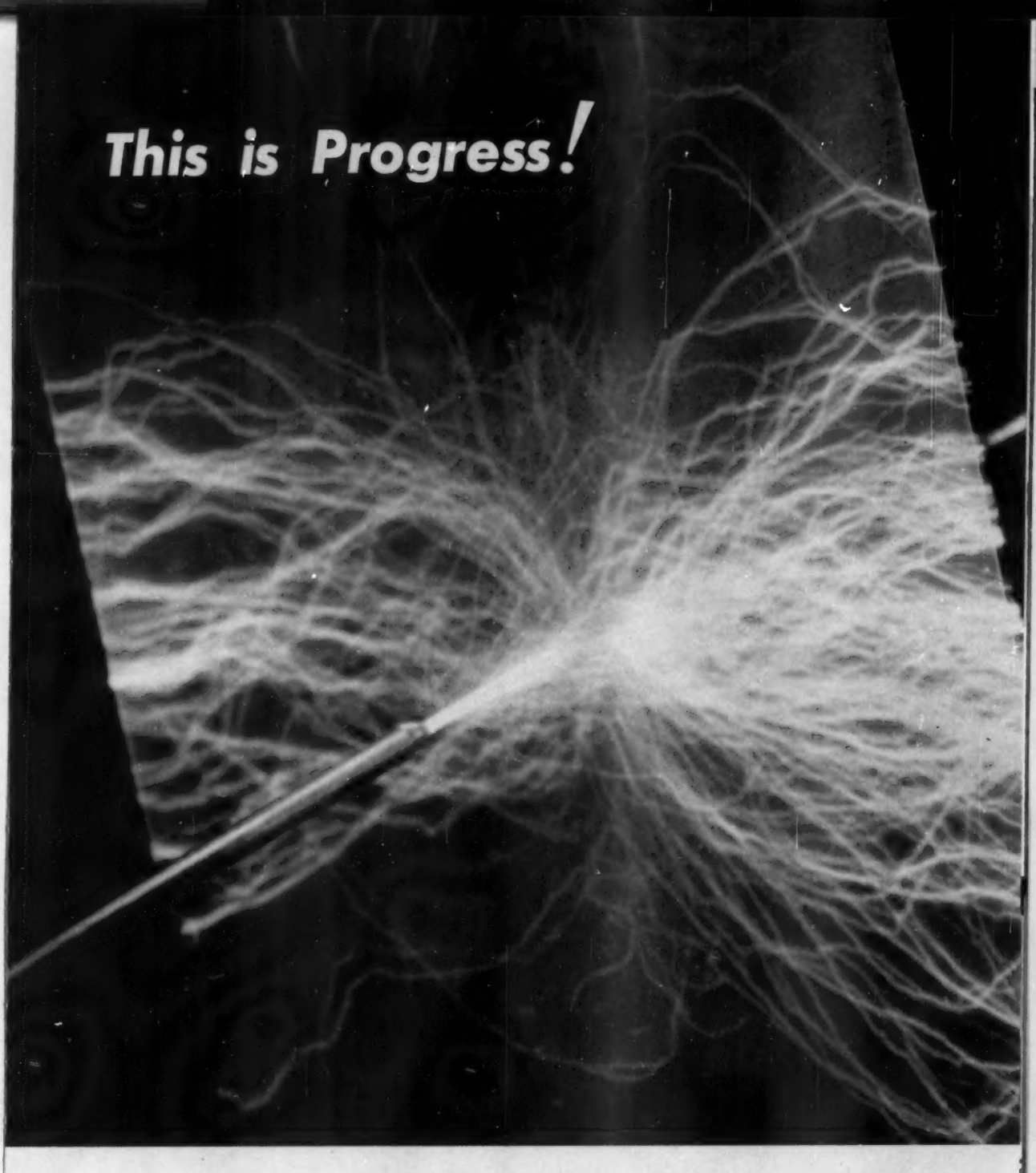
155 To Unload Frozen Cars — Two methods for quickly unloading frozen coal cars are presented in Bulletins 1063D and 1041. The former describes and illustrates portable hopper car thawing tube equipment of both the compressed air and torch flame burner types. The latter bulletin is devoted to oil- or gas-fired prefabricated thawing pits for the radiant heating of coal hopper cars. Hauck Mfg. Co.

156 Stainless Tubing — How to control corrosion with stainless tubing and pipe is told in this 28-pp booklet. Fully illustrated with photos of parts and applications, it provides corrosion resistance tables, charts, reports from users, test results and other engineering data. While covering many types of stainless alloys, this informative book also describes characteristics and performance of super corrosion-resistant steels. Main forms of corrosion are described, along with a breakdown of basic types of applications for stainless tubing and pipe in anti-corrosion service. Information is also given on selection, and specific alloys suggested for varying conditions. Alloy Tube Div., The Carpenter Steel Co.

157 Chemical Cleaning — Technical information on how preventive maintenance cuts replacement costs is contained in this pamphlet which describes how dirty and clogged filter beds were restored to operating efficiency through chemical cleaning. Describes company's preventive maintenance program. Dowell Inc.

158 Air Conditioning Units — Completely revised, 32-pp Catalog 7554 covers fan performance data, heating and cooling coil performance, filter data, data on mixing boxes, and physical and dimensional data. Other features include typical selection examples and specifications for company's air conditioning units. Young Radiator Co.

159 Magnetic Impulse Rapping — This 6-pp bulletin describes company's MI Rapper, a device for automatic and continuous cleaning of the collection electrodes in an electrostatic precipitator. Includes a schematic diagram of the rapper, an explanation of its basic operating principles, and illustrations of its components. Research-Cottrell, Inc.

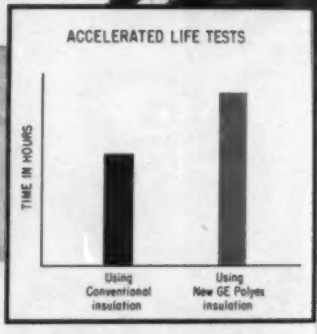


HIGH-POTENTIAL TESTS HELP PROVE . . .

NEW INSULATION MAKES G-E MOTORS LAST 50% LONGER

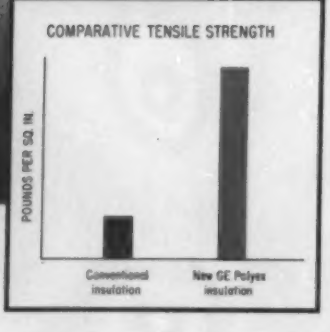
See Details Inside

50% LONGER MOTOR LIFE



IN ACCELERATED LIFE TEST, General Electric's new Polyex insulation proved that it could take extreme heat aging and mechanical stress. Here is a summary of test results...

7 TIMES GREATER PHYSICAL STRENGTH

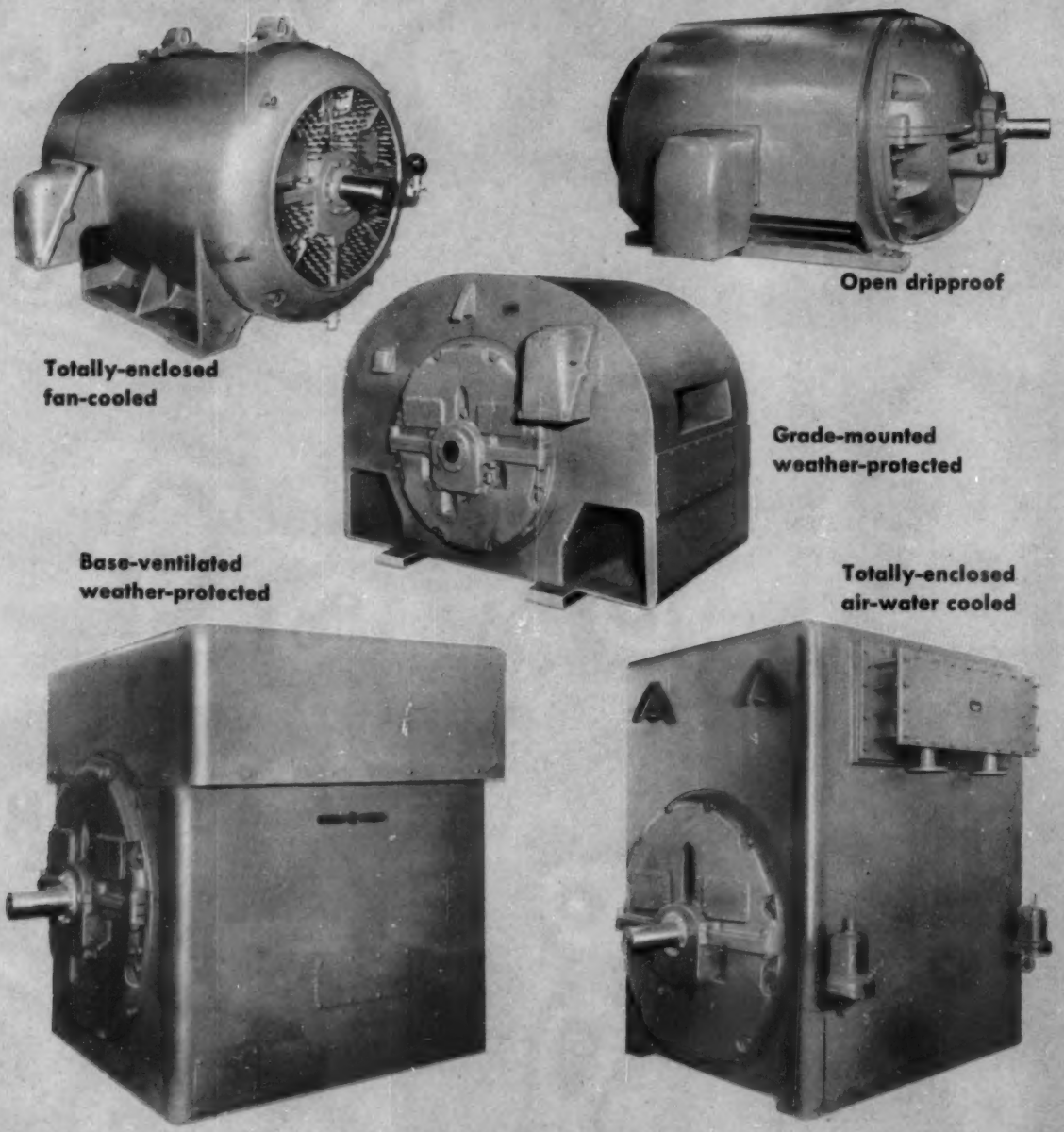


TENSILE STRENGTH of new insulation offers a greater protection against physical stress.

CUT-THROUGH STRENGTH, seven times greater than conventional insulation, is another reason for long life.

NOW AVAILABLE IN MANY RATINGS OF THESE G-E INDUCTION MOTORS

(Approximately 100 to 3000 hp)



Progress Is Our Most Important Product

GENERAL ELECTRIC

...GER MOTOR LIFE

An engineering achievement of vital importanc

General Electric Deve
That is 7 Times Tou

REVOLUTIONARY *POLYEX* INSULATION TAKES FULL ADVAN
OF THE AMAZING PROPERTIES OF NEW POLYESTER FILMS AND

...ew Polyex insulation proved that it ...ss. Here is a summary of test results...

General Electric has developed a completely new Class A insulation for form-wound coils which lasts 50% longer than other insulations in use today. Its greater ability to withstand physical and thermal stresses provides an added margin of protection that will mean tremendous savings to you because of reduced motor failures and maintenance costs.

POLYEX INSULATION is a balanced system of polyester films and fibres, together with new hydrocarbon resins. Materials in new Polyex insulation have high dielectric and physical strength. For the first time, the cotto... based tapes and sheets in conventi... tions have been eliminated.

RESULTS OF EXHAUSTIVE TES... Polyex insulation are summarized on...

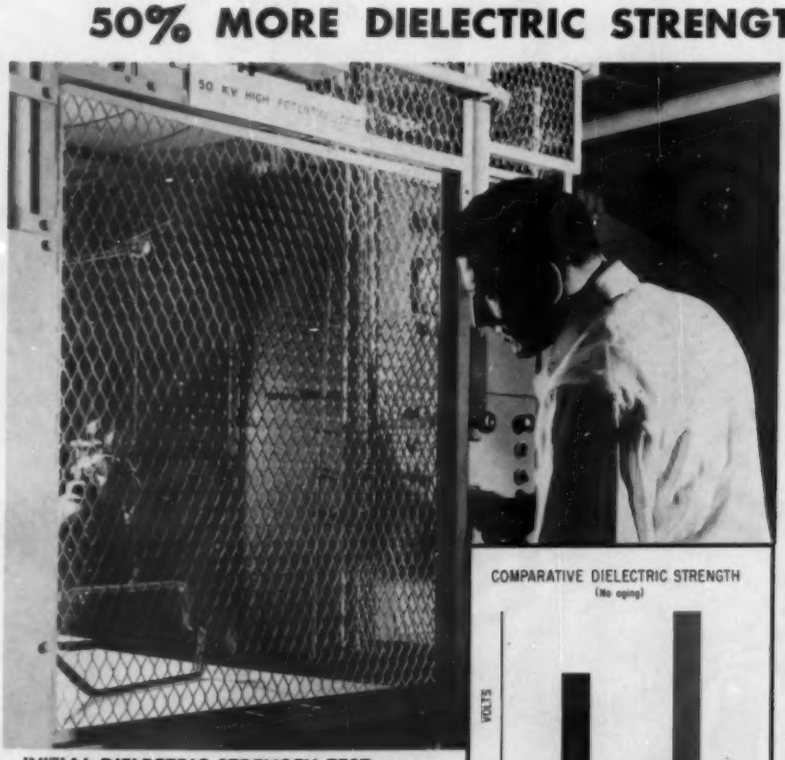
Insulation qualities like these o... mendous savings in motor maint... a greater degree of service conti... ever before possible.

GENERAL ELECTRIC RESEARCH ... insulation is a continuing progra...

...ER PHYSICAL STRENGTH

CUT-THROUGH STRENGTH, seven times greater than conventional insulation, is another reason for long life.

50% MORE DIELECTRIC STRENGTH, EVEN ...



INITIAL DIELECTRIC STRENGTH TEST measures insulation's ability to withstand operating and starting voltages, and the protection offered against insulation failure.

BAKED FOR THO... 125°C, Polyex ins... It proved that it ... and dielectric pro...

ınce to users of motors with form-wound coils . . .

velops New Insulation for Motors ugher, Adds 50% to Motor Life

ANTAGE
AND FIBRES

otton and paper-
ventional insula-

TESTS on new
d on these pages.
se offer you tre-
maintenance and
continuity than

RCH for better
rogram. Polyex

insulation is the latest result of that program. Three years of intensive development and testing of materials and manufacturing techniques culminated in the most significant advance in large motor insulation in 45 years.

POLYEX INSULATION IS NOW AVAILABLE in many ratings of General Electric induction motors in the range of 100 to 3000 HP—and at no extra cost.

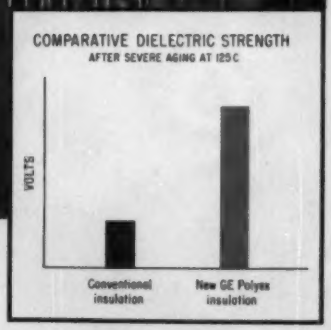
YOUR G-E SALES REPRESENTATIVE has complete information. Contact him at your nearby General Electric Apparatus Sales Office. *General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

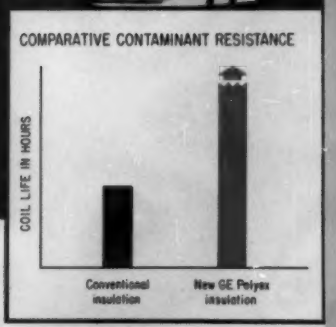
I AFTER HEAT AGING

THOUSANDS OF HOURS at
x insulation was tested again.
at it retains its higher physical
c properties after heat aging.

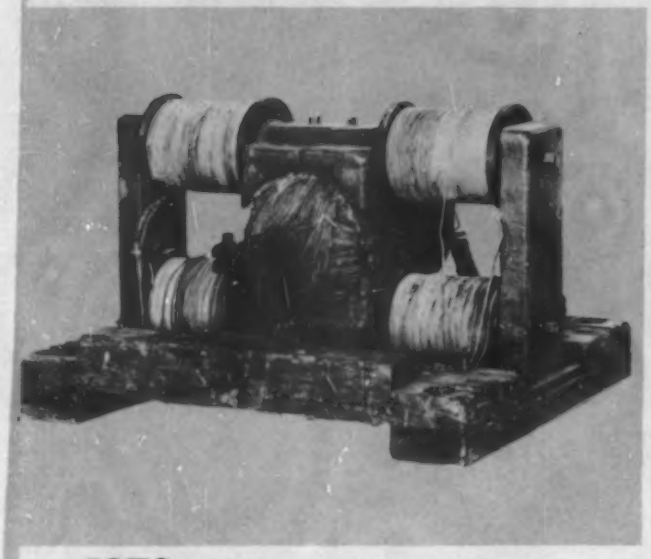


CONTAMINANT RESISTANCE DOUBLED

IN SALT SOLUTION, insulation's ability to resist contaminants was tested. Polyex-insulated coils were still operating long after conventional coils had failed.

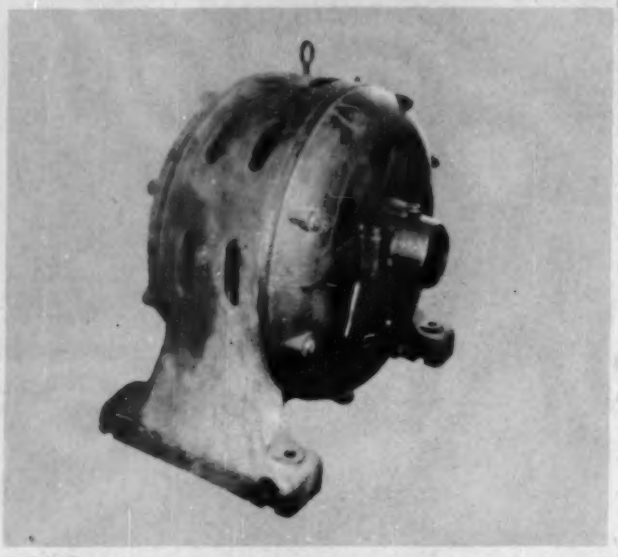


THE THIRD MAJOR STEP IN THE EVOLUTION OF FORM-WOUND MOTOR INSULATION SYSTEMS



1878—FORM 1 INSULATION SYSTEM

Air was the insulator in early motor coils. Cotton was wrapped around the coils, but served only as a spacer to provide an air gap. The cotton wrapping itself was worthless as an insulator.

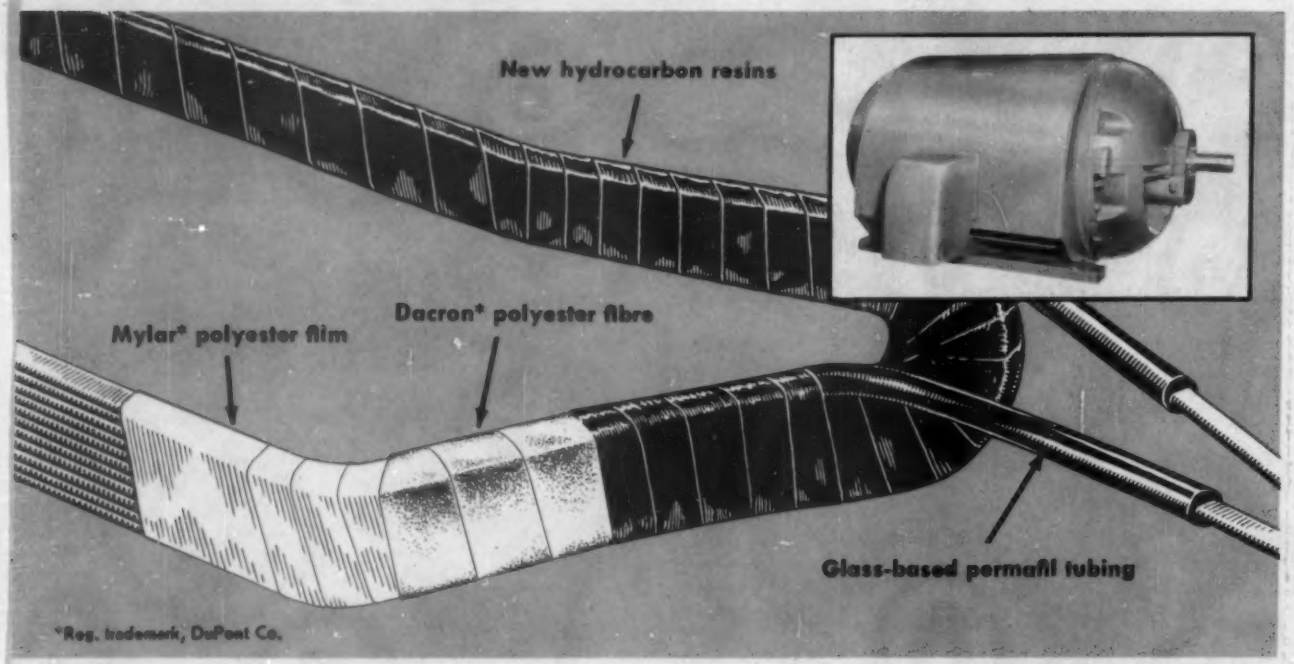


1910—FORM 2 INSULATION SYSTEMS ESTABLISHED

Linseed oil was added to cotton to provide insulating qualities. Since then, varnish and other insulating materials have replaced oil, but until now the basic concept has remained the same.

1954—G.E. INTRODUCES FIRST FORM 3 INSULATION SYSTEM

New G-E Polyex insulation becomes the first Form 3 insulation system. Made of polyester films and fibres, Polyex is the first insulation in which the materials have natural insulating qualities of their own.

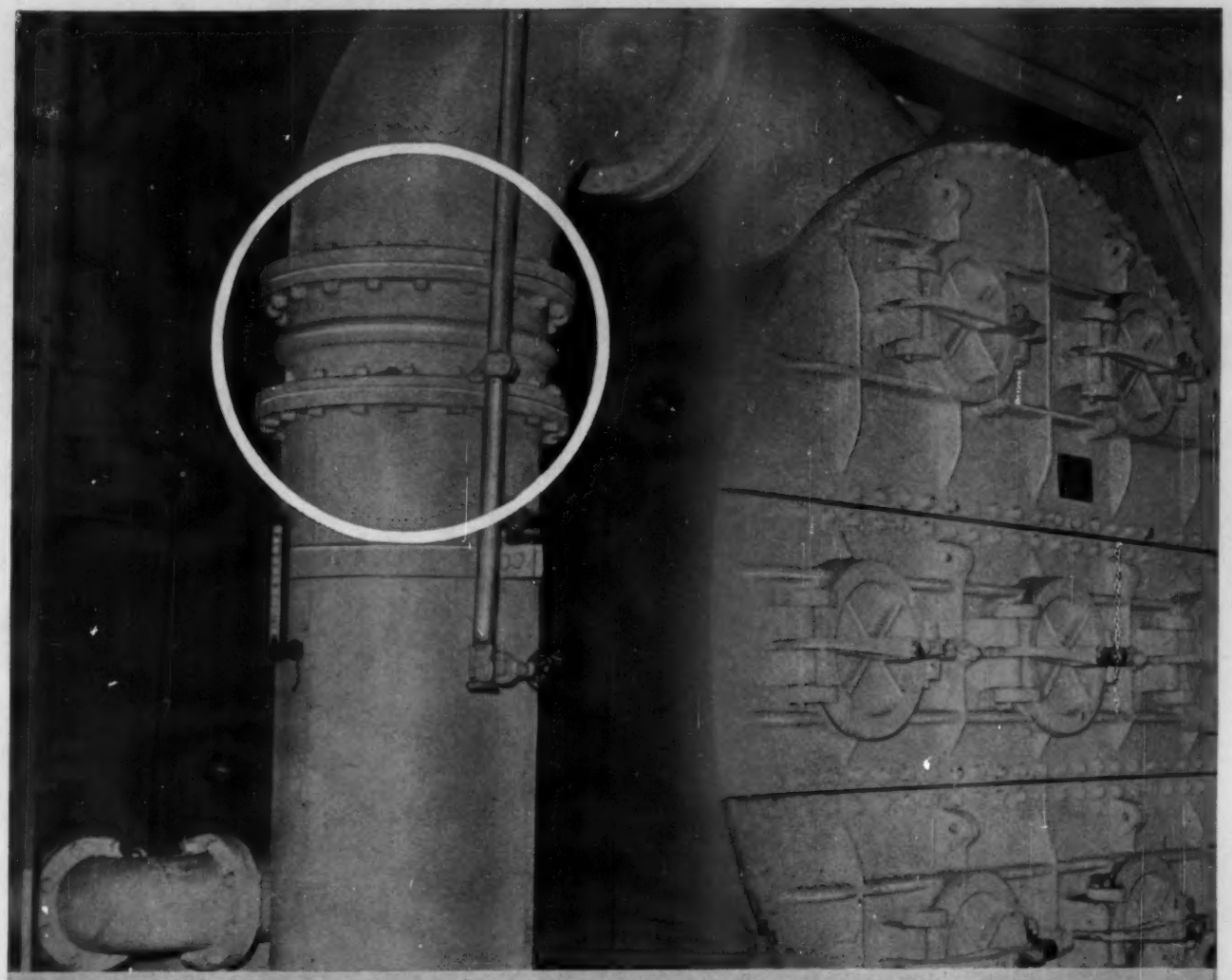


Progress Is Our Most Important Product

GENERAL ELECTRIC

830-14

Want to keep this information? Tear along perforated edge.



30-YEAR SERVICE RECORD CHALKED UP BY U. S. EXPANSION JOINTS IN WEST COAST POWER PLANT

Above is one of 12 U.S. Expansion Joints installed 30 years ago in a California utility plant. Despite their age these joints are still functioning.

U.S. Rubber Expansion Joints are economical, flexible connections used in pipe lines to take up the stresses due to vibration, expansion and contraction. They prevent the transmission of noise, and take care of misalignment. They have no moving parts to wear or bind and thereby shorten service life.

U.S. Rubber Expansion Joints can be installed on both new and old piping and equipment. These joints plus engineering service are available through any of our 27 "U.S." District Sales Offices, or write address below.

"U.S." Research perfects it...
"U.S." Production builds it...
U.S. Industry depends on it.

US RUBBER

UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tape • [illegible] Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

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Specification

To assure maximum fuel saving
and steam plant efficiency,
specify

HAGAN
automatic combustion control
and
HAGAN
ring balance instruments

for Saving Fuel

The fuel saved by the average system of Hagan Automatic Combustion Control pays back the initial investment within the first year of operation. Comparable savings continue as long as the boilers last. This is a clear profit, amounting to many times the price of the Hagan Automatic Combustion Control.

The indications and records of Hagan Ring Balance Instruments provide the operators with the performance picture necessary for maintaining top efficiencies.

The design and construction of all components stress durability, accuracy and versatility. There is a system of Hagan Automatic Combustion Control and Ring Balance Instrumentation for every boiler plant, with any number or size of boilers, operating at any steam pressure and temperature, and burning all types of fuels, singly or in multiple.

Hagan methods and Hagan equipment are also operating successfully in such applications as:

- Boiler drum water level control, with automatic set point adjustments available.
- Superheated steam temperature control.
- Steam pressure reduction and spillover control.
- Draft or pressure control over a continuous range from fractions of an inch water column to 5000 psig.
- Feedwater heater pressure or temperature control.
- Recording, indicating and integrating flows of water, steam, liquid and gaseous fuels.
- Simultaneous records of two separate flows, measured in a single meter housing.
- Pressure and temperature compensated records of steam and gas flows.
- Density compensated records of boiler drum water level.
- Pneumatic and electric signal transmission for remote recording.

For modernization or extension of existing installations, or for new construction, our engineers will be glad to suggest the best system to fulfill your requirements.

HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automatic and Aeronautical Testing Facilities

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DROP FORGED STEEL

valves, fittings and flanges by Vogt

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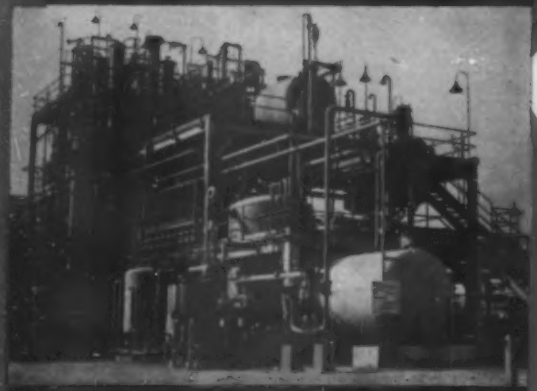


CHEMICAL PLANTS

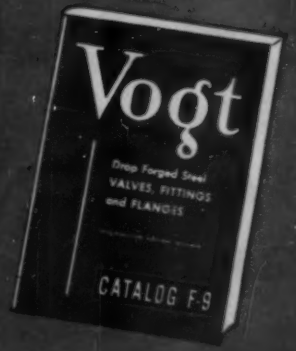
POWER PLANTS

USED and TRUSTED by the NATIONS KEY INDUSTRIES

There are good reasons behind the trust which America's key industries have placed in Vogt valves, fittings, and flanges for half a century. They know that *drop forged materials* are uniform in structure, fine grained, and free from porosity. They know, too, and appreciate the meticulous care given these products through every stage of forging and machining in Vogt's modern shops, and about the many rigid tests and inspections. And that is why these products enjoy such an impressive record of performance in withstanding the shocks and stresses imposed by high or low pressures and temperatures and in resistance to erosive and corrosive conditions.

Service is another important factor in this confidence because Vogt maintains the world's largest and most complete stock of drop forged steel valves, fittings, and flanges always ready for immediate shipment.

Write for Catalog F-9. Consult its 400 pages for the complete Vogt line of drop forged steel valves, fittings, and flanges for oil, steam, water, air, gas, and refrigeration services.



HENRY VOGT MACHINE CO., LOUISVILLE, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland
St. Louis, Dallas, Charleston, W. Va., San Francisco

HENRY VOGT MACHINE CO. ... 75th Anniversary

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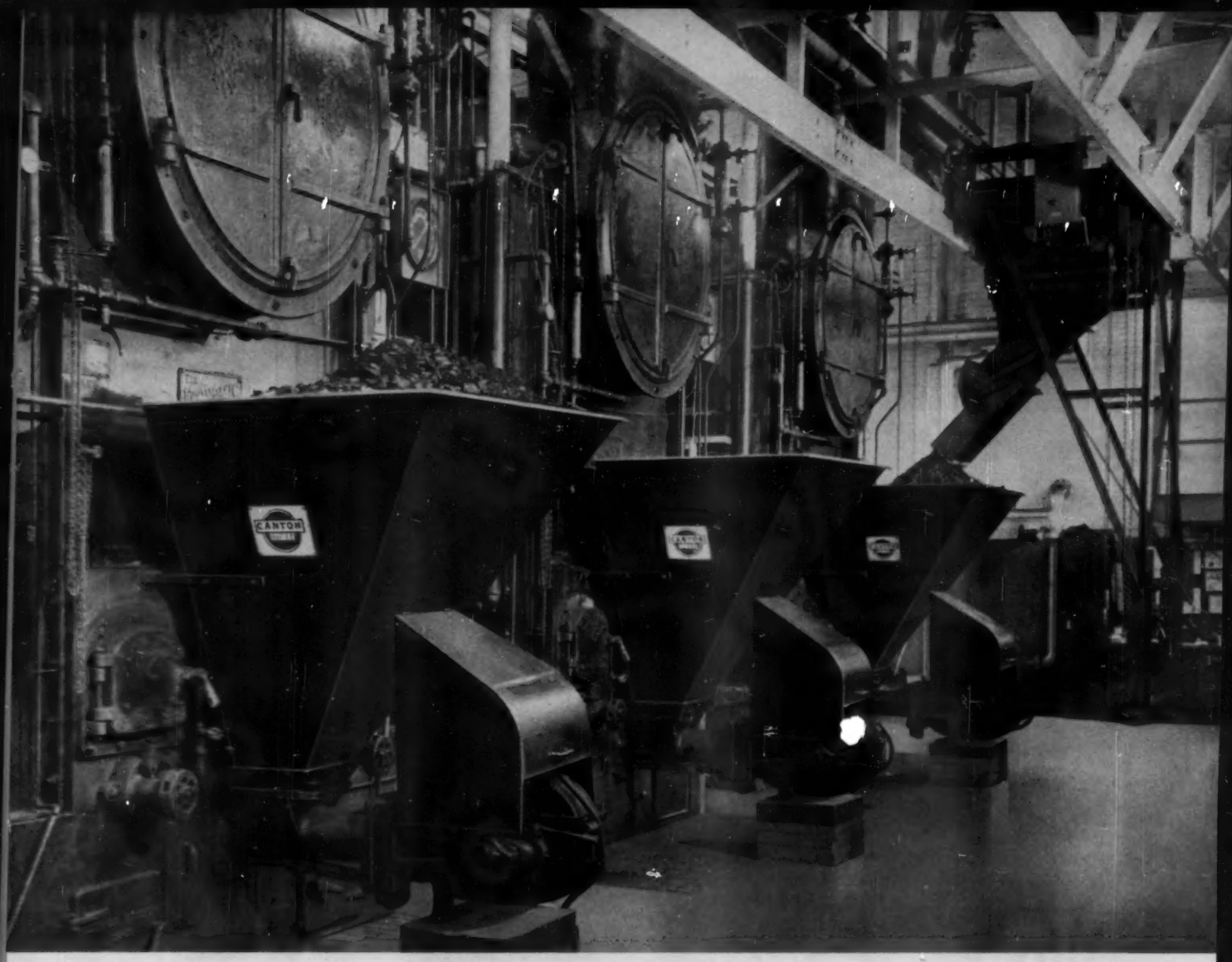

Burning coal the modern way saves Lakewood Hospital 22% in fuel costs

When Lakewood Hospital, Lakewood, Ohio, recently enlarged its facilities, the hospital authorities decided to install a new boiler plant. After careful consideration, they chose coal.

Today the hospital's automatic coal-burning equipment supplies steam at high efficiency to laundry, kitchen, sterilizers and heating system. The coal is handled and burned cleanly, meeting rigid sanitary requirements. And, based on local rates, coal costs $4,068 less per year than natural gas and $6,348 less than oil! Using the lower figure, burning coal the modern way has effected a 22% savings in fuel costs.

Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars every year.

facts you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can cut your labor cost to a minimum.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

BITUMINOUS COAL INSTITUTE
A Department of National Coal Association
Southern Building, Washington 5, D.C.

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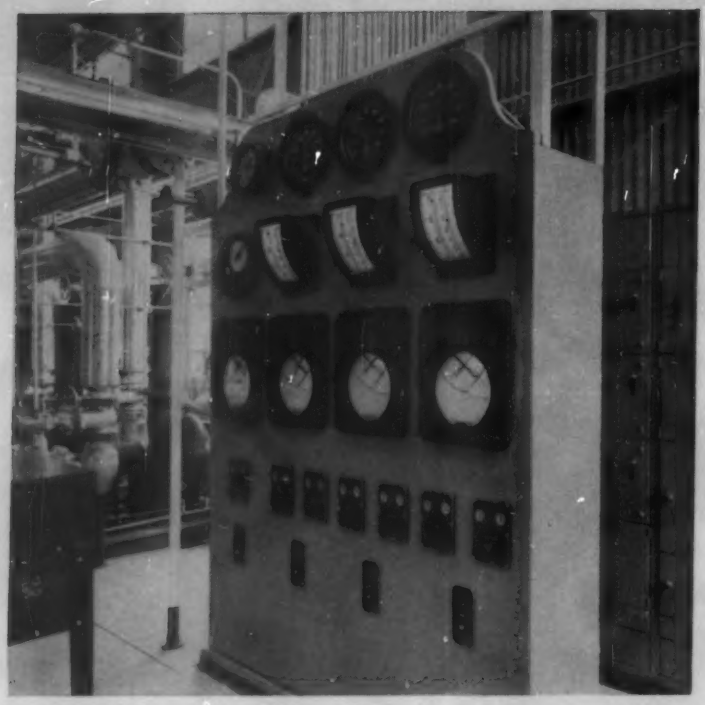


Bailey Boiler Control Panel for three 150,000 lb per hr, 400 psi, gas-fired boilers. Meter at left records total Steam Flow; the other three meters record Gas Flow—Air Flow and Flue Gas Temperature.

How to Control Steam Costs

★ Close regulation of fuel and air input is vital to a strict control of your steam cost. But that's not all. You'll need control of other factors, too. Your costs can be held down only by controlling all of the important operations in your steam plant. That's where you can be sure of help from Bailey Controls. Here's why they can do the job and do it right:

1. Suitable Equipment

When you receive equipment recommendations from a Bailey Engineer his selections come from a complete line of well-engineered and carefully tested products.

2. Seasoned Engineering Experience

Your local Bailey Engineer brings you seasoned engineering experience based on thousands of successful installations involving problems in measurement, combustion, and automatic control.

3. Direct Sales-Service—close to you

For your convenience and to save time and travel expense there's a Bailey District Office or Resident Engineer in or close to your industrial community.

For greater fuel savings, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're glad to stand on our record.

A-125-1

FORMULA
for Cutting
Steam Costs
•
+ Bailey Design
+ Bailey Engineering
+ Bailey Service
= Greater Savings
per Fuel Dollar

BAILEY
METER COMPANY
1040 IVANHOE ROAD
CLEVELAND 10, OHIO
Complete Controls for Steam Plants

BAILEY METERS
Controls for
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMP

For more data circle 529 on Post Card

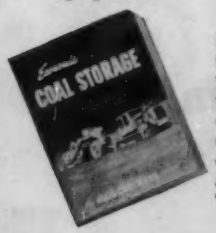
MODERN METHODS of Coal Handling

14 TONS OF COAL AT A TIME is stockpiled or reclaimed at an Eastern utility by this HD-20 Tractor with special Baker coal blade. Blade design takes advantage of tractor's big 175 net engine hp, permits moving up to 15 percent more coal than with regular blade. Repeated trips of 25-ton unit over stockpile compacts coal, helps prevent spontaneous combustion.

COKE IS STOCKPILED AT A STEEL MILL leveled and compacted by this Allis-Chalmers 72 drawbar hp HD-9 Tractor — then is reclaimed as needed for the plant. Wintertime operation no longer is hindered by freezing of coke surface as it was with system previously used.

COAL IS RECLAIMED AS NEEDED from the storage pile of a Michigan industrial plant by this Allis-Chalmers 109 drawbar hp HD-15 Tractor with Gar Wood straight blade and wings. It moves about 9 tons of coal at a time. Unit also stores coal, which is brought in by rail. Tractor handling of coal is flexible, can either supplement existing facilities or take over complete job. Permits adding storage areas without installing costly conveyors, tracks, etc. — or abandoning them without leaving money tied up in idle equipment.

VERSATILE HD-9G WITH 3¾-YD. (2.8-TON) BUCKET builds storage pile of coal brought to Midwest industrial plant by truck. These coal-handling buckets are available for all four Allis-Chalmers tractors, from 2-yd capacity on the HD-5G to 7-yd on the HD-20G. Blades and other attachments are interchangeable with buckets to widen the usefulness of Tractor Shovels.



Find out more about how Allis-Chalmers equipment can improve your coal handling at lower cost. See your Allis-Chalmers dealer for a demonstration right at your plant, or ask to see the color film showing coal-handling equipment at work. Also, send for free booklet, "Economic Coal Storage."

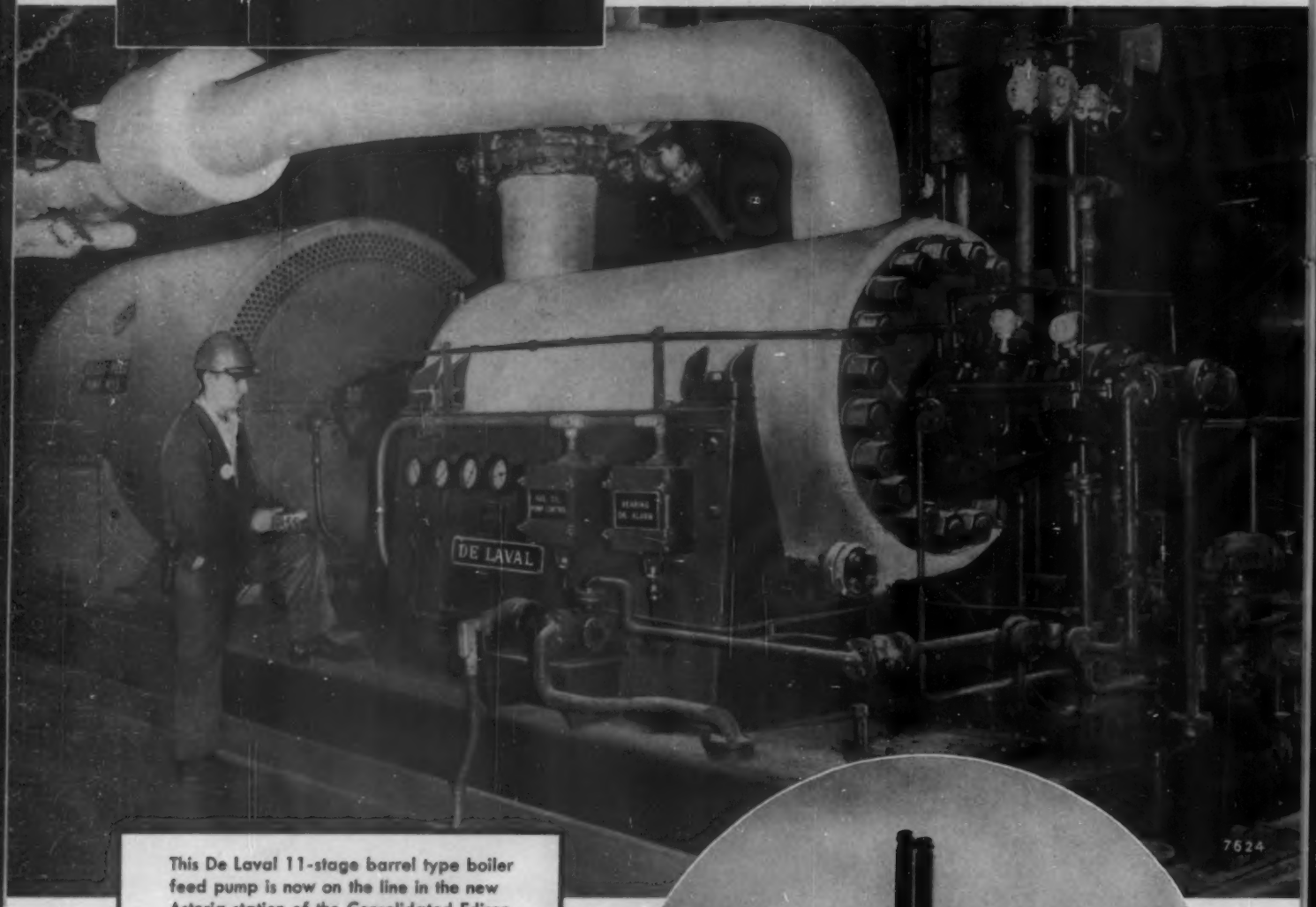
For more data circle 530 on Post Card

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

DE LAVAL
BARREL TYPE BOILER FEED PUMP

in new Con Edison *Astoria power station*



This De Laval 11-stage barrel type boiler feed pump is now on the line in the new Astoria station of the Consolidated Edison Co. of New York.

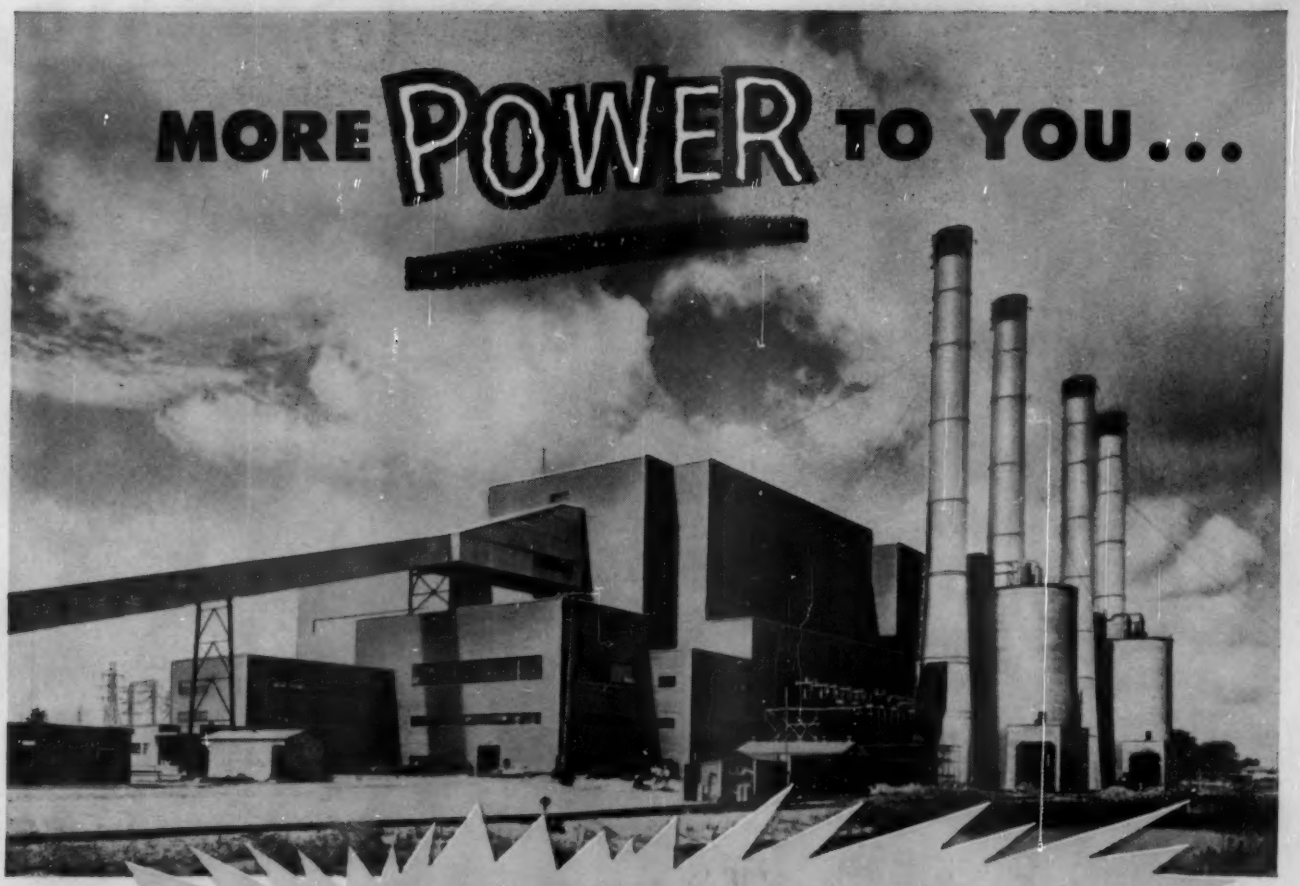
The De Laval 8/6 pump operates at 129 psig suction pressure and delivers 1,570 gpm of 344 F water against 2,229 discharge pressure. Direct-connected at the end of the boiler feed pump shaft is a De Laval IMO pump for lubrication of the main pump and motor bearings. Also furnished is a motor-driven De Laval IMO auxiliary oil pump with pressure controlled switches. De Laval barrel type boiler feed pumps meet all the requirements of high pressure, high temperature boiler feed service. The distinctive De Laval design assures years of reliable operation with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL-289



Detroit Edison Plant boosts U.S. Electrical Capacity to 100,000,000 KW.

Detroit Edison's St. Clair plant boosts U. S. generating capacity to a new high. The last St. Clair unit, rated at 156,250 kw., to go on the line brought the total U. S. electrical capacity to over 100 million kw. Shell Turbo Oil 27 was purchased as the lubricant for this unit as well as for the other three turbine generators in this plant.

Shell Oil Company extends heartiest congratulations to Detroit Edison Company for their part in achieving this industry milestone in electrical power.

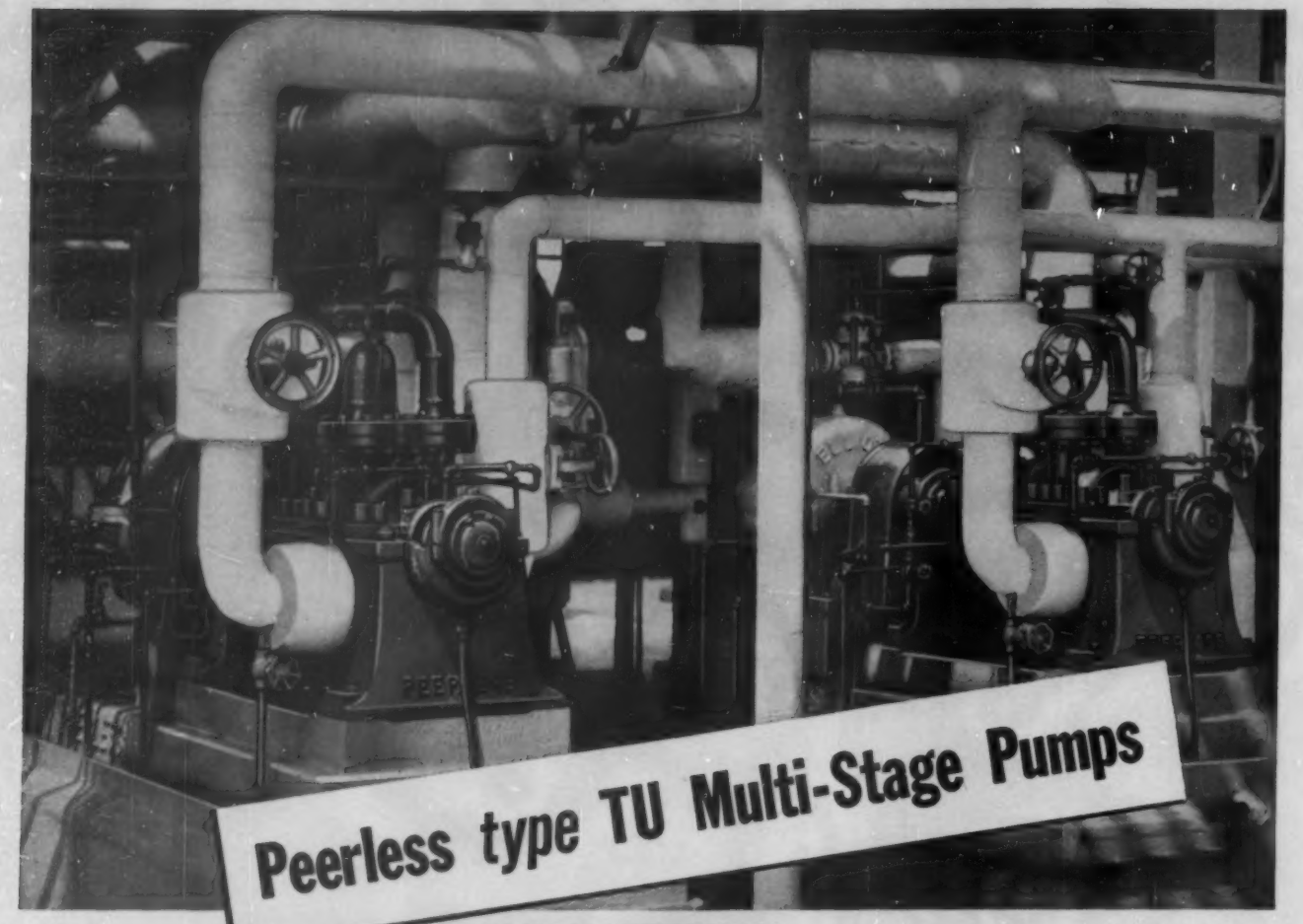
Shell is proud of its long association with the great electrical industry.

SHELL OIL COMPANY

50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

For more data circle 532 on Post Card



Peerless type TU Multi-Stage Pumps

PEERLESS PUMPS

4 COST-SAVING FEATURES OF THE TYPE TU LINE

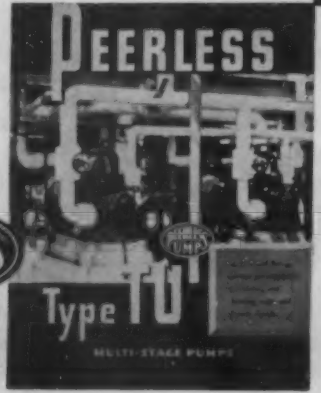
- *SIMPLICITY IN DESIGN*
- *GOOD HYDRAULIC CHARACTERISTICS*
- *DURABLE, RUGGED CONSTRUCTION*
- *ON-THE-JOB DEPENDABILITY*

2, 3, 4 AND 5-STAGE PUMPS FOR SUPPLYING CIRCULATING AND BOOSTING WATER AND PROCESS LIQUIDS AGAINST MEDIUM AND HIGH HEADS. Put these dependable pumps to work for you. They'll deliver high maintained efficiencies over an extended service life. Their split-case design makes them easy to service and maintain. Their precision construction guarantees year after year durability. In all sizes 4" and under, cross over between stages is built integral with upper pump case. Over-size shafts, wear rings, shaft sleeves, heavy duty ball bearings, modern case and impeller design are outstanding features. Choose from many types and sizes for all head and capacity requirements.

PROFUSELY ILLUSTRATED BULLETIN. A new 4-color bulletin describes the Peerless Type TU pumps. It's complete with pump cross-section, dimensional drawings and load-capacity data. Use coupon below.

GENERAL SPECIFICATIONS

HEADS	Up to 1600 Feet
CAPACITIES	Up to 3000 GPM
TEMPERATURES	Up to 300°F
CASE PRESSURES	Up to 800 Lbs.
HP RANGE	Up to 325 BHP
DRIVES	All Types
CONSTRUCTION	Cast Iron, Bronze, Stainless



MAIL COUPON FOR NEW BULLETIN

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send a copy of TU Pump Bulletin No. B-1400 to:

NAME_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

PO. ENG.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

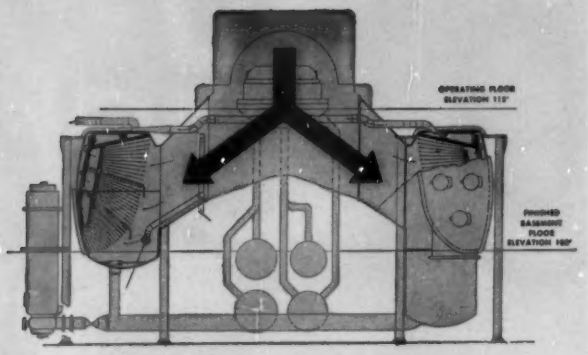
Address inquiries to Factories at:
Los Angeles 31, Calif. & Indianapolis, Ind.
Offices: New York; Chicago; Indianapolis; St. Louis; Atlanta; Plainview and Lubbock, Texas; Fresno; Los Angeles; Phoenix; Albuquerque, New Mexico.
Distributors in Principal Cities; Consult your Telephone Directory

PEERLESS PUMP
fmc

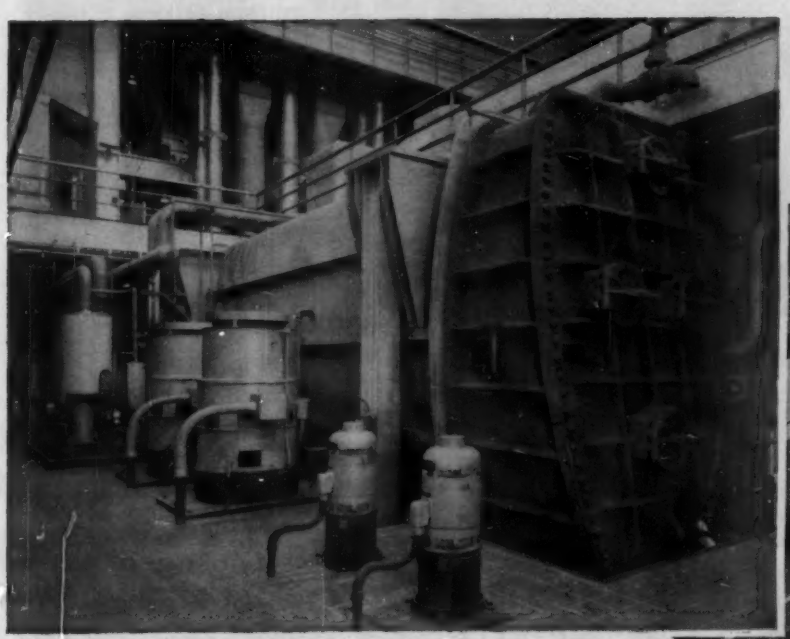
For more data circle 533 on Post Card

new angle

in turbine-exhaust-condenser arrangement



saves headroom and construction costs at Kearny Generating Station



One of the FW side-mounted condenser shells from basement level, showing deflection columns, condensate pumps and heater drain pumps.

General view of turbine room at Kearny station, showing one of the twin condenser shells and the side-exhaust turbine.

The slightly unorthodox surface condenser illustrated above is one of two 70,000 sq. ft. side-turbine-exhaust units designed and built by Foster Wheeler for Public Service Electric and Gas Company, N. J. Serving a 145,000 kw turbo generator at the new Kearny Generating Station, it has effected important overall economies in station construction.

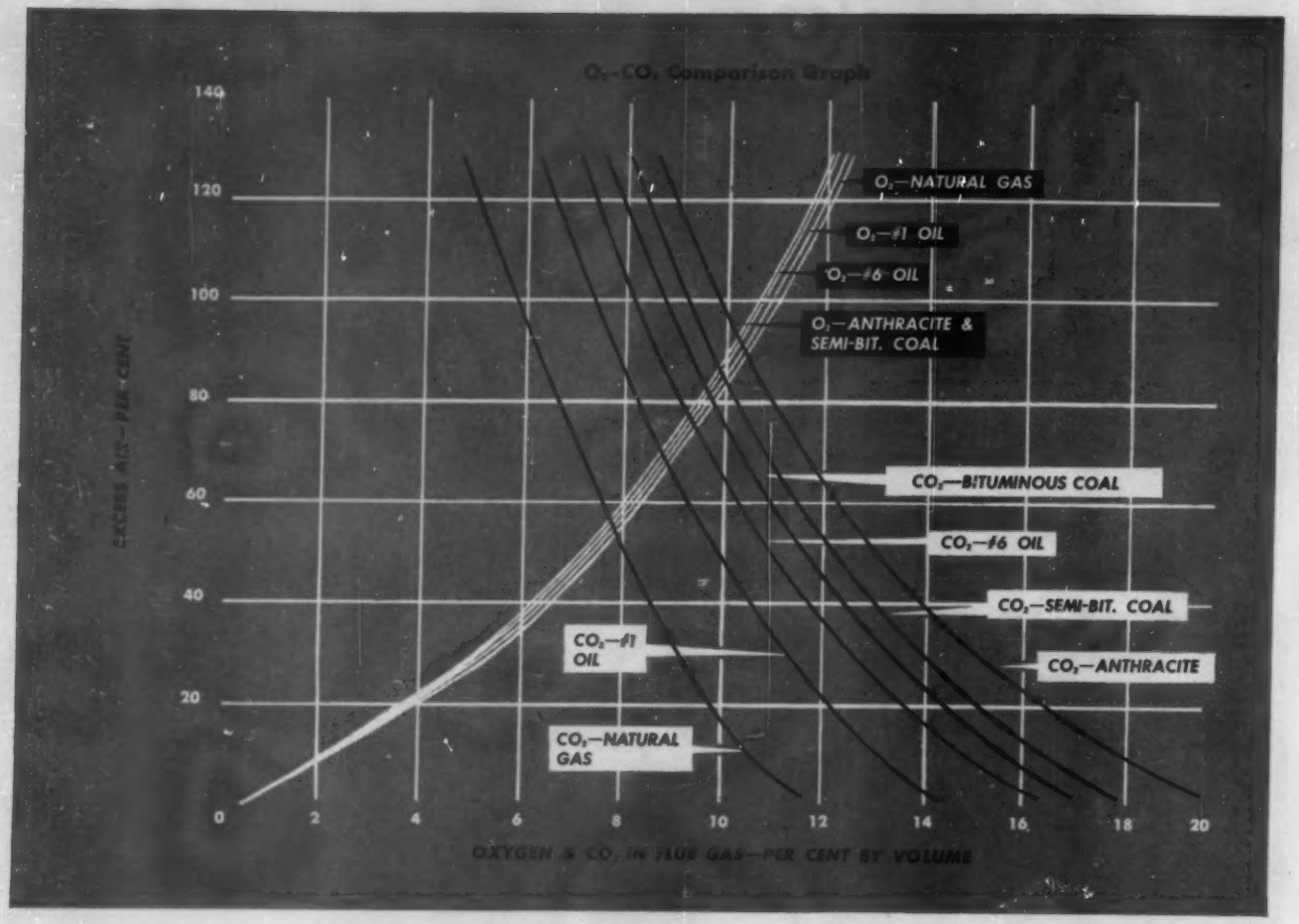
Total height from basement level to turbine operating level is only 15 feet. This low height was achieved without appreciable increase in turbine discharge path, which feeds directly into the twin single-pass condenser shells through a short divided exhaust piece. Careful studies showed that the reduction in headroom was a definite economic advantage. The space below the exhaust piece is effectively utilized by four feedwater heaters.

Each half of the condenser shell is suspended from four deflection columns which allow for thermal expansion without the customary expansion joint or spring arrangement.

Specializing in the design and construction of steam generators, surface condensers and feedwater heaters, Foster Wheeler is fully equipped, engineering and productionwise, to meet your requirements for the modern steam plant. For further information write for HE-3-54. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

FOSTER WHEELER

For more data circle 534 on Post Card



HOW TO BURN Multiple Fuels EFFICIENTLY

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely.

Large savings possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

With the purchase of a Hays Magno-Therm Oxygen Recorder, they found that they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 52-829-56 — describing the Magno-Therm Oxygen Recorder. Write for this free information.

With the Hays Magno-Therm Oxygen Recorder you get:

- *Continuous, highly accurate indication and recording.*
- *Complete compensation for temperature and pressure effects.*
- *Freedom from chemicals or hazardous fuel burning in the analyzing process.*
- *Swift, sure electronic operation.*

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 7, INDIANA

For more data circle 535 on Post Card

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 3 | FEBRUARY 1955 | Number 1

It Takes a Lot of Water Conditioning To Manufacture an Automobile

And the water problems in some two hundred auto manufacturing plants serviced by Hall Laboratories are almost as varied as the number of operations required to put a new automobile on the highway.

Service records of the Hall engineers tell the story:

In the Boiler House:

Automotive Hardware Plant No. 62
Report by H. A. Redu

No. 2 Boiler (over 30 years old) has been baffled as per our recommendations to reduce carry-over. In line with mechanical changes, continuous blowdown systems have been installed on all of the boilers so that a control program for regulating the rate of blowdown can be set up.

Units which had been opened reflected considerable improvement in sludge distribution. These improvements were realized not only because of mechanical changes, but also by the very close control maintained over boiler-water conditioning.

In Plant Processing:

Metal Fabricating Plant No. 83
Report by J. A. Ivancic

Processed parts of sheet aluminum came through cleaning with electrical resistance so high that welding of the finished product was difficult. Resistance amounted to hundreds of microohms on the surfaces instead of the maximum acceptable resistance of 35 microohms. Plant men suspected change in water supply might be responsible.

Working with the capable plant engineer, our process specialist Kurt Albrecht spotted other possible sources of trouble when he was called in to study the problem. In the deoxidizing bath, conditions were such that appreciable silicic acid salts could plate out on the aluminum. At the final rinse stage, acid dosage did not compensate for the wide variations in alkalinity of different water supplies. The type of wetting agent being used in this operation further contributed to the surface resistance of the finished parts. Finally, drying methods evaporated rather than removed rinse solution, leaving solids of high resistance.

Close control of deoxidizing is now being maintained by the improved methods recommended. Constant use of deionized water and elimination of acid feed (carry-over from deoxidizing now provides the correct pH of solution) minimized the pick-up of solids in the final rinse. Blasting with compressed air to remove rinse water further reduced the surface resistance of the parts. More reliable measurement of resistance has resulted from an improved method.

Plant men informed us that Kurt Albrecht got them squared away ok on their aluminum cleaning problem.

In the Condensate Return System:

Engine Plant No. 142
Report by R. R. Christian

Tank engine plant showed marked corrosion reduction during a test period feeding a maximum of 2.5 ppm. of Hagafilm. Comparative tests showed corrosion reduction of 98 percent in the boiler house lines, and 89 percent in the main manufacturing building.

In Plant Water and Cooling Systems:

Automotive Assembly Plant No. 7
Report by F. R. Duesing

Major cause of production delays in this assembly plant was frequent burning out of tips on water-cooled spot welding guns. Tips were plugging up with dense hard material, shown by lab tests to be corrosion product, calcium carbonate scale, and some asbestos dust from a neighboring plant taken into the system by way of the cooling tower.

Threshold treatment, using the new Calgon® Composition T, which allows very low phosphate reserve and a comparatively broad pH range, eliminated scale formation and corrosion. But the asbestos dust being caught in the cooling tower and so introduced into the recirculating system still plugged the welding gun tips. Filters were recommended and installed to handle only the water supplying the welding guns.

Combination of chemical and mechanical treatment has now eliminated burn-outs.

Automotive Assembly Plant No. 34
Report by L. P. Dougherty

Experience on a previous job at an assembly plant serviced by Hall engineer S. R. Osborne led the power plant engineer to start a new tank plant off right by treating well supply with glassy phosphate, and a closed cooling system with chromate.

At the new plant the treatment of well water and the recirculating system is being carried out without a hitch.

* * *

Manufacturing automobiles is the business of all these plants. Hall Laboratories' part in getting the cars on the road is to help the industry to obtain the most service from the millions of gallons of water being used in its plants.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Can I use this sheet packing on hot oil lines, too?
Sure J-M Service Sheet is equally good for oil, steam and gas lines!
Johns-Manville

Your J-M Packings Distributor can tell you why this quality sheet packing has maintained such an excellent reputation for over 35 years

Where it's used: Every industrial plant can use J-M Service Sheet Packing to advantage. It's the favorite packing of thousands of plant engineers and maintenance men. Both versatile and dependable, Service Sheet makes a tight, long-lasting seal against superheated steam, air, gas, water, hot oil and ammonia, as well as many acids and chemicals.

What its advantages are: J-M Service Sheet is a quality packing, made of selected long-fibre asbestos bonded with heat-resisting compounds. It is graphited on one side to permit breaking a joint without destroying the gasket. The ungraphited side is ruled into one-inch squares to speed cutting and reduce waste. And . . . you can order it in large economical quantities because J-M Service Sheet will not dry out in stock!

How it is furnished: Service Sheet is supplied in sheets 54″ x 63″, 36″ x 126″, 36″ x 63″, and 54″ x 126″ sheets in thicknesses of 1/64″ to ¼″ and 108″ x 126″ sheets in thicknesses of 1/32″ to ¼″. It is also furnished as cut gaskets in standard and special shapes. See the J-M catalog for further details.

Your J-M Packings Distributor carries complete stocks of J-M Service Sheet and other quality Johns-Manville Packings. He can help you choose the right packing for your application. Write him for complete information and copy of folder PK-19A, "Thousands of Plants Rate It Tops." Or address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.

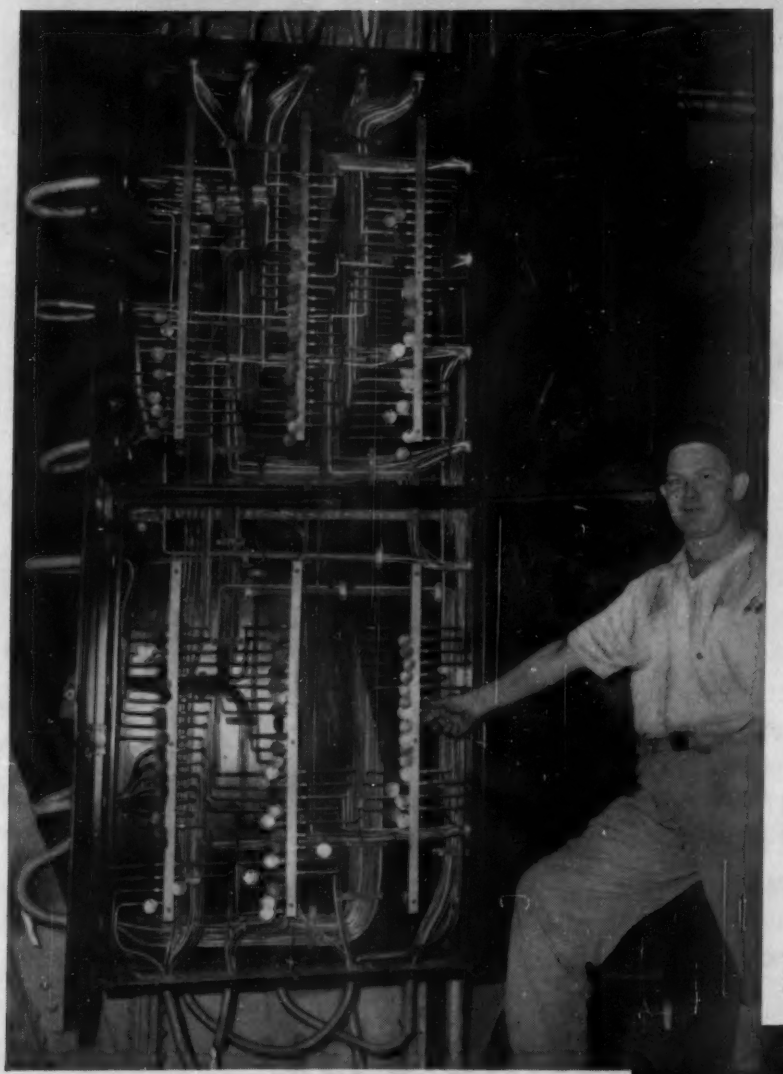
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

For more data circle 537 on Post Card

FOR INSTRUMENTATION AND CONTROL

Cabled Tube



Control Junction Box at Power Station of Long Island Lighting Company, showing use of Crescent Armored Multitube. Note that relatively sharp bends can be made without damage to the cabled copper tube.

Some time ago Revere ran an advertisement featuring Crescent Armored Multitube for use in pneumatic and hydraulic instrumentation and control systems. The advertisement created so much interest that we thought you might like to see a photograph of an actual installation. The Control Board Junction Box shown here has 22 runs of Multitube coming into this box comprising 224 Revere Copper Tubes of 1/4" O.D. The picture was taken in the Glenwood Landing, N.Y. Power Station of the Long Island Lighting Company. The tubes go to instruments that report information on temperature, main and reheat steam pressure, boiler feed and condensate pump pressure, fuel oil and gas pressure, liquid levels, tide level and for the control of fuel feed, draft dampers, boiler drum water level and various control valves.

This is a relatively new use for Revere Copper Tube, but it is an important one in these days when new ways are being found to obtain process information more quickly and accurately, or to achieve automatic control. Crescent Armored Multitube is made by Crescent Insulated Wire & Cable Co., Inc., Trenton 5, N.J., in lengths up to 1,000 feet. It consists of a group of long tubes twisted together in cable form, protected by a flexible interlocked galvanized steel armor, or by plastic, or both. As many as 19 tubes, 1/4" O.D., can be cabled, with one tube in each layer color-coded. Larger tubes can also be cabled, including 5/16", 3/8" and 1/2". This construction affords protection during shipment, installation and use, and speeds up installation greatly. For further information, write Crescent, and for tube in copper and aluminum, see the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

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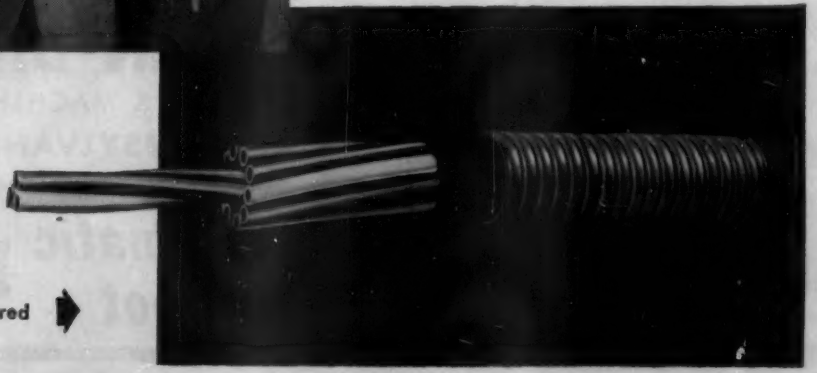
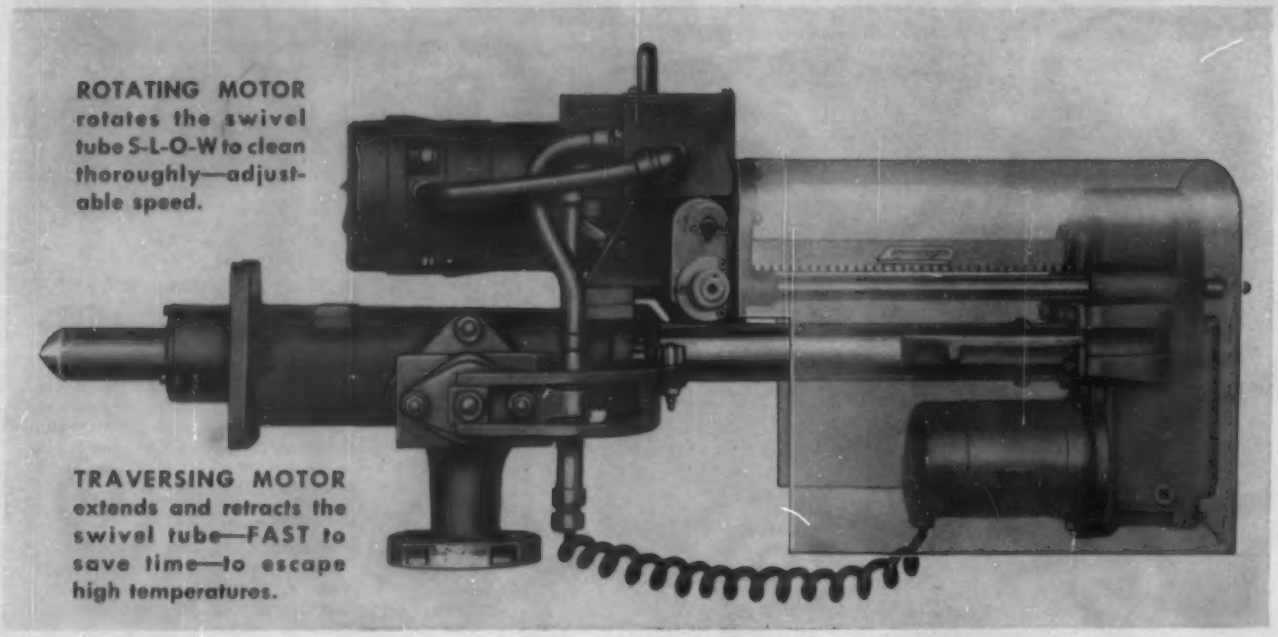
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.



Construction of Crescent Armored Multitube.

For more data circle 538 on Post Card

How to STOP SLAG BUILD-UP


ROTATING MOTOR rotates the swivel tube S-L-O-W to clean thoroughly—adjustable speed.
TRAVERSING MOTOR extends and retracts the swivel tube—FAST to save time—to escape high temperatures.

KEEP slag and sintered dust from upsetting heat-transfer capacity and superheat or reheat control. Stop their build-up—quickly and effectively—with the high-power mass blowing and fast action of Vulcan Wall Deslaggers.

Thanks to dual-motor drive—electric or air, electric shown—a Vulcan Deslagger extends into the boiler, cleans and retracts from the high-temperature zone—all in 76 seconds. The cycle can be repeated often, if needed to control deposits.

Steam, air or water—or any combination of them—may be used as the blowing medium without change in equipment. The blowing or cleaning arc can be any angle up to a full 360 degrees.

VULCAN
Dual-Motor Wall Deslaggers
With direct-acting valve
Clean BETTER and FASTER

The story is told in detail by new Bulletin 1016. Write for it.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE 4, PENNSYLVANIA

VULCAN *Automatic Soot* **BLOWERS**

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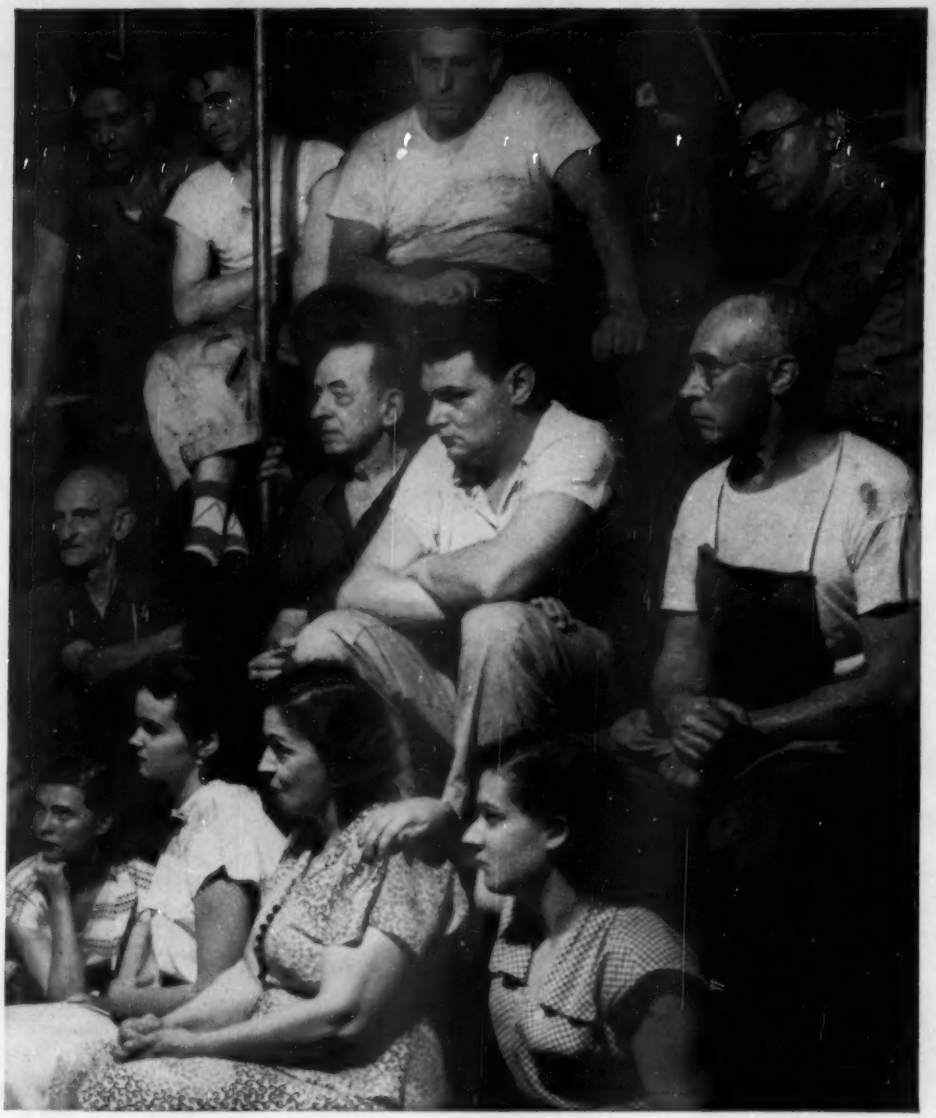

the facts of life

about cancer

The facts of death from cancer are all too familiar. Too many have known the tragedy of losing a family member... a friend... a fellow worker. Too few know the facts of life about cancer. Yet they are there for the asking... or the seeing... or the listening. The American Cancer Society teaches life-saving facts about cancer every day of the year. Through films... pamphlets... exhibits... window displays... via radio... television... newspapers... magazines... from lecturers... information centers... you can learn vital facts that might one day mean the difference between life and death.

The American Cancer Society maintains the first line of defense in the battle against man's cruelest enemy. Teaching you how to protect yourself and your loved ones from death by cancer, supporting research in more than 100 medical and scientific centers, keeping your doctor informed of new techniques of diagnosis and treatment are but a few of the Society's many functions, all of them directed to the ultimate conquest of the disease.

Don't turn away from the facts about cancer. They can be the facts of life for you and your family. Visit the American Cancer Society office nearest you, or write to "Cancer" in care of your local Post Office.

American Cancer Society

WORK DONE - WORK DOING
. . . *for these Companies*

Baton Rouge Electric Company
(*Now part of Gulf States Utilities Company*)
Boston Edison Company
Boston Elevated Railway Company
(*Now Metropolitan Transit Authority*)
Central Illinois Electric and Gas Company
Cliffs Power and Light Company, The
Columbus Electric and Power Company
(*Now part of Georgia Power Company*)
Compania Electrica de Santo Domingo C. por A.
Connecticut Power Company, The
Consolidated Mining and Smelting Company of Canada, Limited
El Paso Electric Company
Great Western Power Co. of California
(*Now part of Pacific Gas and Electric Company*)
Gulf States Utilities Company
Hartford Electric Light Company, The
Houghton County Electric Light Company
(*Now part of Upper Peninsula Power Company*)
Hydro-Electric Power Commission of Ontario, The
Indiana Electric Corporation
(*Now Public Service Company of Indiana, Inc.*)
Jamaica Public Service Company, Ltd.
Key West Electric Company, The
(*Now Key West Electric System*)
Louisiana Steam Generating Corporation
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Lowell Electric Light Corporation, The
Luzerne County Gas & Electric Corporation
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(*Now part of Ohio Edison Company*)
Mississippi River Power Company
(*Now part of Union Electric Company of Missouri*)
Montaup Electric Company
New Bedford Gas and Edison Light Company
Newport Electric Corporation
Niagara Mohawk Power Corporation and predecessor companies
Northwestern Electric Company
(*Now part of Pacific Power & Light Company*)
Pacific Gas and Electric Company
Pacific Light & Power Corporation
(*Now part of Southern California Edison Company*)
Philadelphia Electric Company, The
Potomac Electric Power Company
Public Utility District No. 1 of Chelan County, Washington
Puget Sound Power & Light Company
Queens Borough Gas & Electric Company
(*Now part of Long Island Lighting Company*)
Roanoke Rapids Power Company
(*Now part of Virginia Electric and Power Company*)
Sao Paulo Light and Power Company Limited
Savannah Electric & Power Company
Sierra Pacific Power Company
Southern California Edison Company
Southern Utah Power Company
Susquehanna Power Company, The
(*Now part of Philadelphia Electric Company*)
Tampa Electric Company
Union Electric Company of Illinois
Union Electric Company of Missouri
United Power & Light Corporation, The
(*Now part of The Kansas Power & Light Company*)
Upper Peninsula Generating Company
Virginia Electric and Power Company
Western Massachusetts Electric Company
Western United Gas & Electric Company
(*Now part of Commonwealth Edison Company*)
Williamsburgh Power Plant Corporation
(*Now part of New York City Transit Authority*)

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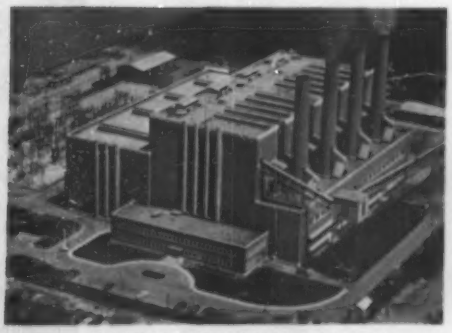
More than 100 power plants also have been designed and built for leading industrial companies.

Write or call us for information as to how our experience* may be of assistance to you.



RICHARD L. HEARN STATION

OSAGE HYDRO DEVELOPMENT

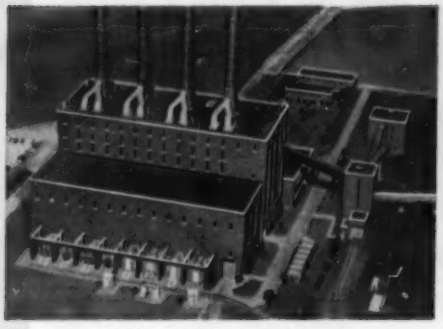
WANETA HYDRO DEVELOPMENT

* ***EXPERIENCE:*** **Starting 65 years ago, the Corporation's work in the steam power field alone aggregates in excess of 11,300,000 kw in capacity, equivalent to about 16% of the utility steam generating capacity in the United States. Hydroelectric projects, with a capacity equal to about 10% of the present privately-owned hydroelectric capacity of the United States, also have been built by the Corporation.** ***These installations, both steam and hydro, have ranged from small industrial or utility installations to superpower stations.***

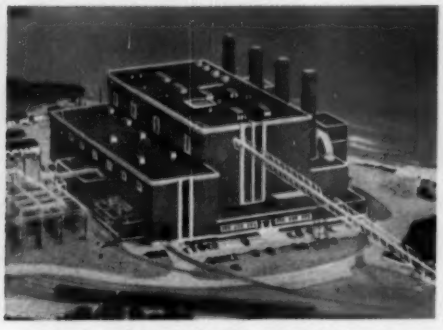
ETIWANDA STEAM STATION

CHESTERFIELD POWER STATION

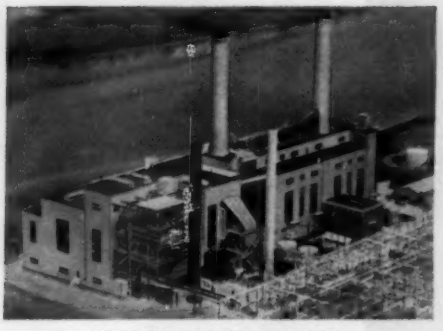
SOMERSET STATION



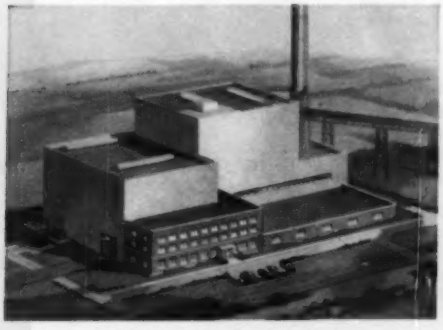
OSWEGO STEAM STATION



POTOMAC RIVER STATION



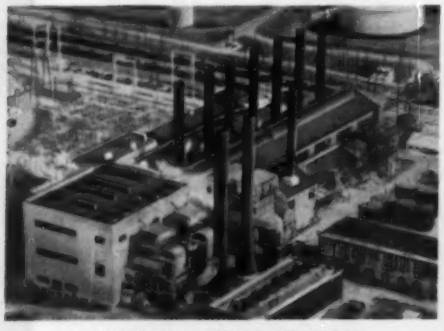
NECHES POWER STATION



MIDDLETOWN STATION

ROCK ISLAND HYDRO PLANT

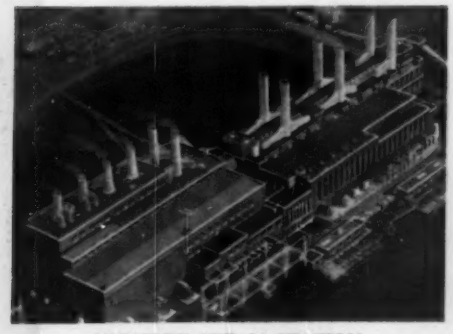
CARIBOU STEAM STATION



LOUISIANA STEAM STATION

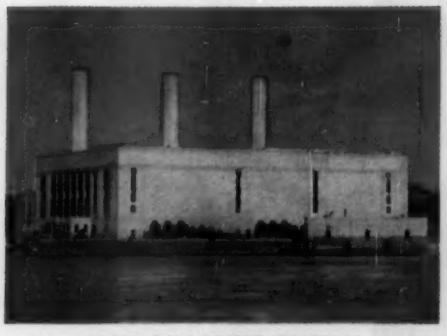
SABROOKE POWER STATION

HOOKERS POINT STATION



HUNTLEY STEAM STATION

MOSS LANDING STATION



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CONSTRUCTION NEWS

Anchorage, Alaska — Chugach Electric Association, Anchorage, has made application to Federal Power Commission, Washington, D. C., to proceed with construction of new hydroelectric generating plant at Cooper Lake, Kenai Pensular district, previously noted in these columns. Proposed plant will have a rated output of 12,000-kw., and is estimated to cost $6,650,000, with switching stations, transmission lines, power substations and other operating facilities.

Phoenix, Ariz. — Arizona Public Service Co., Phoenix, has arranged for a sale of preferred stock to total about $7,500,000, portion of proceeds to be used for new construction, expansion and improvements in generating facilities. As recently reported, company has plans in progress for new steam-electric generating plant at Tempe, Ariz., with rating of 100,000-kw.

El Segundo, Calif. — Los Angeles Water & Power Dept., 311 South Spring St., Los Angeles, Calif., has negotiations in progress for purchase of tract of land in vicinity of El Segundo, to be used as site for proposed steam-electric generating plant. It is understood that this will form part of 1955–56 expansion program. Details of installation are expected to be determined soon.

Long Beach, Calif. — Los Angeles Water & Power Dept., 311 South Spring St., Los Angeles, Calif., has authorized plans for new steam-electric generating plant in vicinity of Long Beach, to be located on tract of about 200 acres of land, fronting on San Gabriel River. Size and details of station will be determined soon. Entire project is reported to cost about $85,000,000.

Long Beach, Calif. — Southern California Edison Co., 601 Fifth St., Los Angeles, Calif., will proceed with construction of new Alamitos steam-electric generating plant, fronting on San Gabriel River, near Long Beach. Initial installation will comprise a 156,000-kw. turbine-generator unit, high-pressure boilers and auxiliary equipment, and will represent the first of four such units at new plant. Station has been designed to use either oil or gas as fuel. First unit is scheduled to be ready for service in 1956. Cost reported about $24,000,000, with transmission lines, power substations and other facilities.

Denver, Colo. — Public Service Co. of Colorado, 900 15th St., has preliminary plans under way for new steam-electric generating plant, to be known as Cherokee station. Turbine-generator, high-pressure boilers and auxiliary equipment will be installed for large capacity. Entire project is reported to cost in excess of $15,000,000. It is understood that work will begin in 1955.

Chicago, Ill. — Commonwealth Edison Co., 72 W. Adams St., is arranging financing through sale of bond issue in amount of $50,000,000, proceeds to be used in connection with expansion and improvement program during next 48 mos., 1955–58. Entire expenditure during that period is estimated at about $420,000,000, including generating facilities, power substations, transmission and distributing lines and other construction.

Creston, Iowa — Southwestern Federated Power Cooperative, Inc. has plans under way for new addition to steam-electric power plant, with installation of new turbine-generator unit, 7500-kw., and auxiliary equipment, extensions in cooling towers, new coal handling machinery, etc. Cost reported about $2,000,000. Proposed to begin work in spring of 1955. Stanley Engineering Co., Hershey Bldg., Muscatine, Iowa, is consulting engineer.

Henderson, Ky. — Municipal Light Dept. will have plans prepared at once for new addition to municipal steam-electric power plant, with installation of turbine-generator, high-pressure boiler and auxiliary for increased capacity. Bond issue in amount of $3,000,000 has been authorized for project. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

New Orleans, La. — New Orleans Public Service Co. has arranged fund of $6,000,000 through sale of bonds, proceeds to be used in connection with 1955 expansion and improvement program, including generating facilities, power substations, transmission lines and miscellaneous work. Estimated expenditures during that year are placed at $16,200,000 for such work.

Detroit, Mich. — Detroit Edison Co., 2000 Second Ave., is arranging a construction budget for 1955 to cost about $82,000,000, work to include extensions in generating facilities, power substations, transmission lines and other work. As recently noted in these columns, company will install an additional generating unit, 300,000-kw., and auxiliary equipment at new plant at River Rouge, now in course of construction.

Escanaba, Mich. — Escanaba Municipal Utilities has had estimates of cost and preliminary plans prepared by Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, Minn., consulting engineers, for proposed new municipal steam-electric power plant. Installation will include two 7500-kw., condensing steam turbine generating units and auxiliary equipment. Cost estimated close to $4,000,000.

Jackson, Mich. — Consumers Power Co. is arranging financing in amount of $30,000,000 through sale of bonds, proceeds to be used in connection with 1955 expansion and improvement program for power plants, power substations, transmission lines and other operating facilities. Company will make extensions in steam-electric generating station at Muskegon, Mich., recently noted in these columns.

Jackson, Miss. — Mississippi Power & Light Co. has disposed of a preferred stock issue to total about $4,450,000, proceeds to be used in part for 1955 construction, including increased generating facilities, power substations, transmission lines.

Clinton, Mo. — Kansas City Power & Light Co., 1330 Baltimore Ave., Kansas City, Mo., has authorized new steam-electric generating station on large tract of land recently acquired in Henry County, vicinity of Clinton. It will be equipped for an initial rating of 170,000-kw. Coal will be used as fuel. Proposed to begin work early in 1955, with project to be completed in spring of 1958. At that time, work will proceed on a second unit and later, a third unit, with plant to develop a total rating of 460,000-kw., and ultimate cost of about $125,000,000.

Springfield, Mo. — City Council, City Hall, will have plans prepared at once for proposed municipal electric generating plant, recently referred to in these columns, to cost $11,127,000, in which amount bond issue has been approved. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Noxon Rapids, Mont. — Washington Water Power Co., Spokane, Wash., plans new hydroelectric generating plant at Noxon Rapids, where site has been selected. It will be equipped for an initial capacity of 385,000-kw. and is reported to cost close to $85,000,000, including power dam, switching stations, transmission lines, etc. Application for permission has been made to Federal Power Commission, Washington, D. C.

Albuquerque, N. M. — Public Service Co. of New Mexico has disposed of a bond issue of about $1,500,000, proceeds to be used for expansion and improvements in generating facilities, transmission lines, power substations and other work.

Mineola, L. I., N. Y. — Long Island Lighting Co. has disposed of a bond issue of $15,000,000, proceeds to be used for construction program in 1955, which is estimated to cost close to $66,000,000. Work will include increased generating facilities, power substations, transmission lines and other work.

Rochester, N. Y. — Rochester Gas & Electric Corp., 89 East Ave., has authorized new steam-electric generating plant, for which plans will be prepared at once. Installation will include turbine-generator, high-pressure boiler and auxiliary equipment for large capacity; details of installation will be determined soon. Work on foundations will begin early in 1955 and plant is scheduled to be ready for service 24 mos. later. Cost estimated close to $13,000,000, with power substations, transmission lines and other operating facilities.

Charlotte, N. C. — Duke Power Co., 422 South Church St., has disposed of a bond issue to total about $8,700,000, proceeds to be used in connection with 1955 construction program, including expansion in generating facilities, transmission lines and other work, as previously noted in these columns.

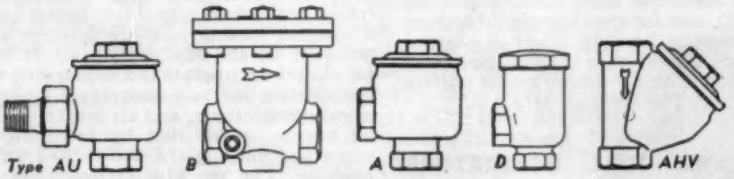
Corpus Christi, Tex. — Central Power & Light Co., 120 North Chaparral St., has plans for new addition to Lon C. Hill steam-electric power plant, near Calallen, with installation of equipment for increased capacity. No estimate of cost announced.

Cassville, Wis. — Wisconsin Power & Light Co., Madison, Wis., will defer construction of proposed new steam-electric generating plant on Mississippi River, near Cassville, previously noted in these columns, until 1957, when work is scheduled to proceed actively. Program will represent a reported investment of close to $20,000,000.

Winter, Wis. — Winter Electric Co. plans new diesel engine-electric generating plant on Chippewa River, Sawyer County, and will proceed with work at early date. Authority has been secured from Wisconsin Public Service Commission.

NICHOLSON Steam Traps'

1. Initial Cost
2. Upkeep Expense
3. Warm-Up Time
4. Production Time



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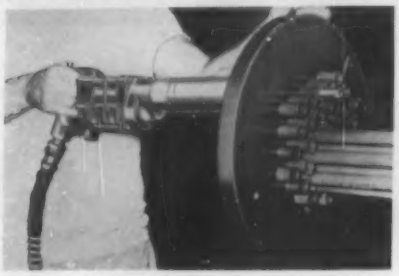
EQUIPMENT NEWS

Described on these pages are new and improved products. Use Reader Service Cards on pages 115–116 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

1—INTERNAL TUBE CUTTER is lightweight, fast working

Described as an accurate fast-cutting tool for removing damaged or leaky tubes from condensers and heat exchangers, this cutter is made of heat-treated alloy steel and has replaceable tool steel double cutters. It is inserted



in the tube and it cuts the tube behind the tube sheet. Manufacturer's tube removal tools are then used to knock out and remove the remaining portion of the tube in the header.

A double-action tool with two cutters, this new internal tube cutter is also self-centering, says company, and features positive feed by lever action control. It is designed to cut steel and nonferrous condenser tubes from ⅝ through 1 in. OD. and for use through tube sheet thicknesses of 1 to 4 in. The ball-bearing collar is adjustable for various tube sheet thicknesses. An air-driven motor powers the cutter. The Airetool Mfg. Co.

2—WATER TUBE GENERATORS for producing low cost steam

Designed for efficient, economical firing with gas, fuel oils, or both, the Type D Superior Steam Generator is announced as a packaged unit offering long service at capacities up to 40,000 lb per hour continuous steaming. It may be combined in batteries for any required total capacity. Outstanding among its design features are the rear-mounted forced draft fan for providing air-cooled furnace roof. By mounting the fan at the rear of the boiler, the firing front is left clear for easy access, and fan noise is removed from the area of the operator. The plenum chamber between fan and wind box provides for installation of steam-air preheater, if desired.

Other features include tangent tube waterwall construction, single or multi-burners, optional soot blowers, adequate manhole and inspection openings, also an air-shielded observation port. Superior Combustion Industries, Inc.

3—LINEAL HEATER in tape and single strand loop types

Line-O-Heat is announced as a strong yet pliable, plug-in electric heating tape to prevent the freeze-up of water pipes, pumps, roof valleys. The tape type is rated at 5 w per foot, 120 v, a-c, and the single strand loop type at 2½ w. The latter comes in 6-, 12- and 24-ft lengths; the tape type comes in six lengths from 3 to 60 ft. In both forms, resistance wire is spiraled on a strong glass core, over which is a double reverse wrapping of Fibreglas. This assembly is then covered with a high-temperature vinyl plastic jacket. Smith-Gates Corp.

4—SILICONE-BASE PAINT for protecting hot surfaces

Formulated of silicone and atomized silver aluminum, Sili-Kool is claimed to resist up to 1600 F while repelling rust and corrosion under severe weather conditions. Tests are reported to show that a single coat of this paint will provide protection for more than a year for red hot stacks, boilers, steam pipes, diesel and gas engines, exhausts. Sili-Kool is announced as the lowest priced of silicone-base paints — a gallon costs about $12.00. It is also available by the pint or quart. A sample is available to qualified power engineers. C. H. Dragert Co.

5—PORTABLE HEATER can also serve as cooling unit

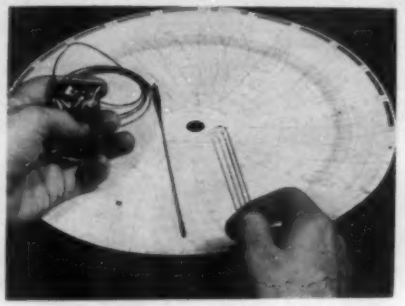
Simplified controls and an attachment which converts this portable heater into a summer cooling unit are features announced for the Model PW-189. It can be placed in operation by plugging in the electric line and snapping a switch, says manufacturer, and air intake of the oil burner is adjusted by loosening a screw and varying the size of the intake opening. The machine is described as self-contained and readily portable and not requiring a vent, flue or chimney.

To convert the heater into a fan you

change the top blower mounting. As a fan, the Model PW-189 delivers 1500 cfm of cool air; as a heater its capacity is 189,000 Btu per hour. Heat is sprayed out at floor level and concentrated in a work zone up to about 6 ft in height. It covers an area of approximately 3000 sq ft, according to company. Dimensions of the new model are 21 by 33 by 58 in. It operates on furnace type fuel oil or kerosene, also on 100 per cent catalytic cracked oil. The fuel tank has a 6-gal capacity. Fageol Heat Machine Co.

6—RECORDING PEN with sealed inking supply system

Besides speeding data interpretation, this featherweight stainless steel pen relieves skilled personnel of monotonous duties. It is fed from a clear, plastic ink sac holding over a year's



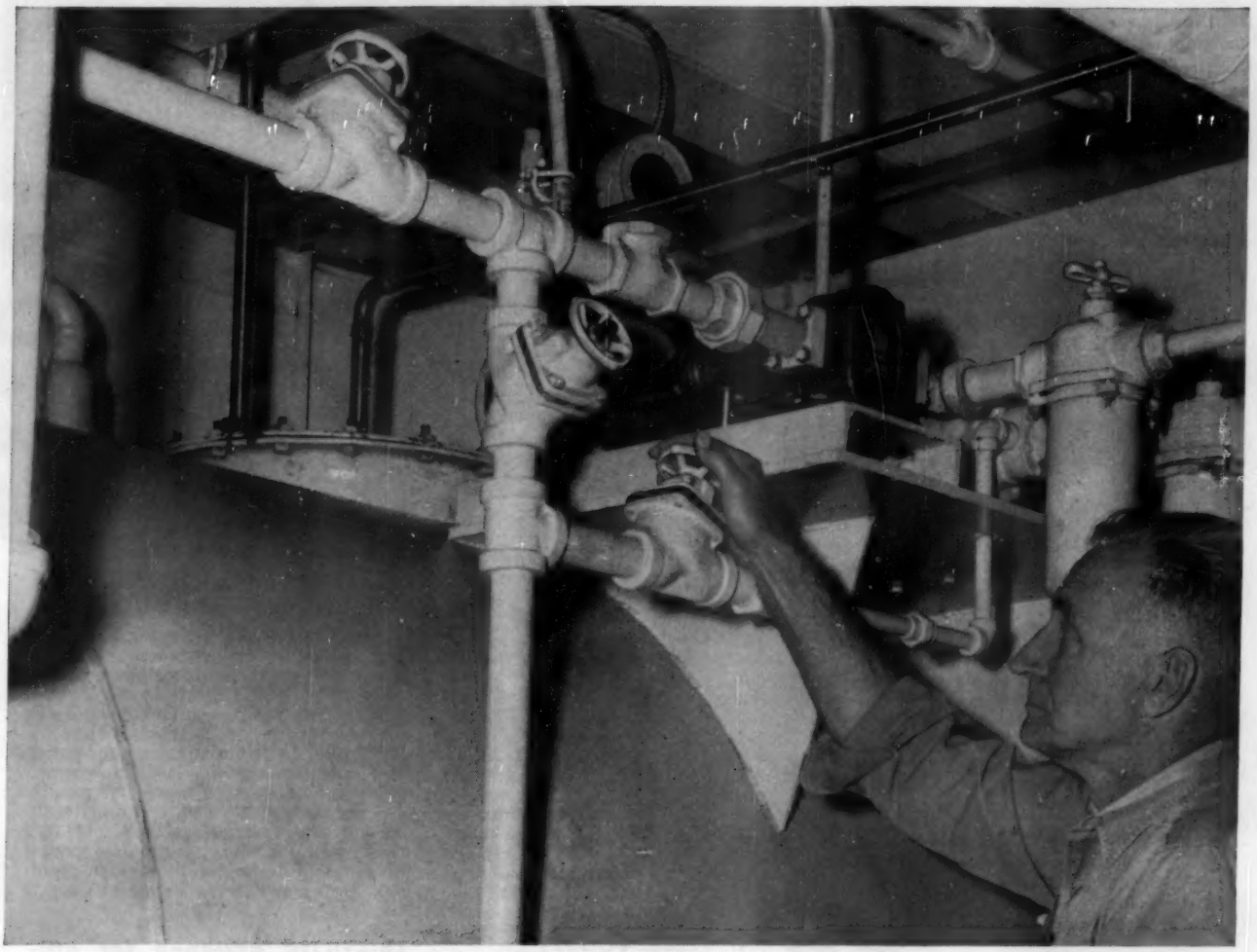
supply. Capillary action maintains a continuous flow to the point which traces a sharp, quick-drying record. Poisoning of intersecting records is practically eliminated, it is claimed, and as many as four pens can trace on parallel time arcs only 0.042 in. apart. The sealed inking system is designed to prevent sludge and oxide formation and said to be contamination proof, noncorrosive and non-evaporating. It is designed for use on manufacturer's new recorder. Bailey Meter Co.

7—50-AMP RECLOSER is a versatile, direct mounting unit

This 50-amp recloser, Type 50-GR-3, for use on 2.3- to 15.5-kv. distribution systems, is designed for use where larger interrupting capacity is not necessary. The recloser is said to be particularly adapted for use with sectionalizers to provide coordinated fault protection on lightly loaded distribution lines. Selective tripping permits choice of one instantaneous and three time-delay trips, two instantaneous and two time-delay trips, or four time-delay trips. This versatility, manufacturer states, facilitiates coordination with other reclosers, sectionalizers, and fuses on the system. The 50-GR-3 is suitable for manual or solenoid operation. It will mount directly on the pole, or in the substation. Westinghouse Electric Corp.

8—TEMPERATURE CONTROL is indoor-outdoor unit

Maximum flexibility with simplified settings for easy adaptation to heating requirements of multiple occupancy buildings is announced as a feature of the Weather-Man control. It has a remote outside temperature sensitive bulb. The regulator case is installed indoors. A program dial is provided to automatically control heat input during



Light oil meets its master in these CRANE VALVES

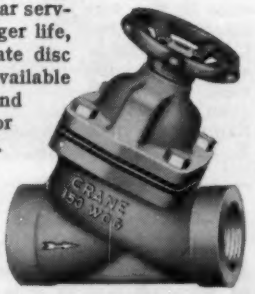
THE CASE HISTORY— Read how the Johnson & Johnson baby products plant at Cranford, N.J., completely stopped a valve leakage condition that wasted product . . . caused a safety hazard . . . and menaced the plant's high sanitation standards.

Valves formerly used on very light baby oil lines were the source of trouble. Keeping them tight at the stuffing box was next to impossible. Constant servicing of stuffing boxes was necessary, even after repacking every 4 to 8 weeks. Several packings were tried without success while the high maintenance costs and nuisance conditions continued.

Early in 1951 the plant found the solution in Crane No. 1610 Packless Diaphragm Valves. They removed the cause of leakage —immediately stopped its troubles and costs. Almost 4 years later—with no maintenance whatsoever—the Crane packless valves remain absolutely tight; continue giving perfect service. And that goes for all valves added since the first installation.

Crane No. 1610 Packless Diaphragm Valves

When you have valve problems with hard-to-hold fluids, try Crane *Packless* diaphragm valves. They eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Their diaphragm has longer life, yet should it fail, their separate disc prevents escape of line fluid. Available in wide selection of materials and sizes. Ask for folder AD-1942 or see your Crane Representative.



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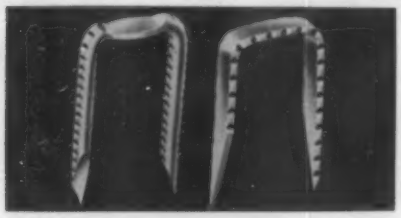
the day, provide night set-back and a morning build-up period — all adjusting according to changes in the weather. A special feature is a manual variator dial which can be positioned to variably increase or decrease amount of heat flow in case of special requirements. A hand switch is also provided for manual operation without disturbing dial program. The regulator is designed to operate with all types of fuel in all types of buildings. Automatic Devices Co., Inc.

9—STEAM TRAP for many condensate load conditions

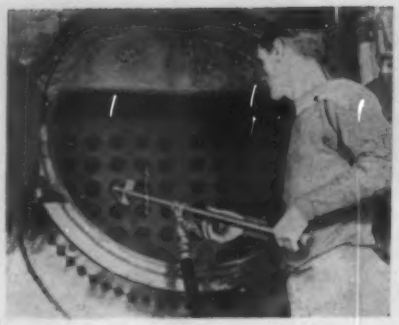
A new line of low, medium and high pressure steam traps, named Hydro-Flex, is available in semi-steel, cast steel and forged steel construction for use on any and all pressures to 2500 psi and temperatures to 1100 F. According to manufacturer, these traps are designed to offer reasonably high capacity and function efficiently even on extremely low condensate loads. In order to promote low maintenance cost, internal working parts of the traps are heavy stainless steel, and buckets are stainless steel, deep drawn without seams or joints. A feature of the new design is the dual fulcrum which powers the valve lever. This includes a primary high leverage fulcrum for cracking the valve from its seat and a secondary low leverage fulcrum to open the valve wide and afford unrestricted flow. Strong, Carlisle and Hammond Co.

10—CABLE STAPLES have barbed edges for good grip

Hold-Tite Staples are announced as having barbed edges which grip the wood and hold firmly. They are designed to hold all sizes of both metallic and non-



metallic flexible cable. This added holding power is said to eliminate sagging cables caused by staples which work loose or drop out. The line includes four sizes in flat wire (⅞ to 1⅜ in. inside length) and two sizes in round wire (1, 1¼ in. inside length). Manufacturer says these staples are made of special steel which will not bend or deform, even when pounded in hard woods. Samples of these staples are available. E. H. Titchener & Co.



14—TUBE BLOWER has high-velocity jet head

This all aluminum automatic tube blower features a newly developed venturi jet head which combines steam and air at tremendous velocity (600 mph at 60 lb steam pressure). Tubes are cleaned from straight on or from a 45 deg angle with a single blast that reaches the outer ring. Blower is also used for cleaning front sheet, uptake, pumps and other machinery and floors. Finger tip control valve is designed to save many pounds of steam. A. W. Chesterton Co.

12—SAFETY SWITCH designed for compactness, economy

This 100-amp circuit breaker safety switch, in a space-saving enclosure which occupies half of space required by comparably rated fused switches, is announced for service on 120/240 v a-c, in two or three wire installations. It incorporates two single-pole hydraulic-magnetic circuit breakers with handle extensions attached to form one double-pole unit, allowing both circuit breakers to be switched on or off together. The unit employs general purpose type circuit breakers in standard ratings of 70 or 100 amp.

The safety switch is said to be economical in terms of both initial costs and maintenance expense. And while it compares in prices with fused switches and other circuit breaker switches, it is designed to eliminate expense of replacing fuses or elements. Circuit breakers in the unit have inverse time delay to prevent nuisance tripping. Minimum and instantaneous trip points are unaffected by heat or cold, manufacturer says, so that safe use of full capacity of the wiring is assured. Bulletin 1411 gives more details. Heinemann Electric Co.

13—GEARED JOINT for transmitting torque around a bend

According to manufacturer, this rugged joint transmits power by a system of bevel gearing and, unlike a universal joint, the geared joint has no maximum angle of operation and will operate in any angle up to 360 deg. Its primary use is for making sharp bends with flexible shaft or reach rod remote controls for valves. When installing valve controls it is often necessary to make sharp bends in the controls to avoid obstacles. The geared joint is said to make it simple to detour around these obstacles, since it can be set for the necessary angle. It is available in three sizes with maximum recommended operating torques of 500, 2000 and 3500 lb-in. Stow Mfg. Co.

15—STEEL NUT for locking electrical conduit, fittings

Easier installations in locking electrical conduit and fittings at panel and junction boxes are claimed possible with the redesigned Bondnut. Made of formed steel galvanized after threads have been cut and protected against corrosion, the new ¾-in. Bondnut has four large perpendicular lugs designed to permit easier tightening with a screwdriver. It also has sharp, beveled bonding teeth on one side designed to cut into the metal wall of panel and outlet boxes for metal grounding and vibration-proof lock. National Electric Products Corp.

16—FILTER designed for efficiency at low cost

The Aerosolve Filter is announced for applications where the extreme efficiency of this manufacturer's Absolute Filter is not required, but where better air cleaning than that afforded by many current air filters is desired. It is expected to find use in comfort air conditioning systems, in critical process air conditioning in industries where clean air is essential, and in situations where a high percentage of dusts or fumes must be kept from escaping. The new device consists of a permanent, cadmium-plated steel frame which contains a fully assembled, replaceable filter cartridge. Three interchangeable cartridges are available with filtering media to provide efficiencies of 95, 85 and 35 per cent.

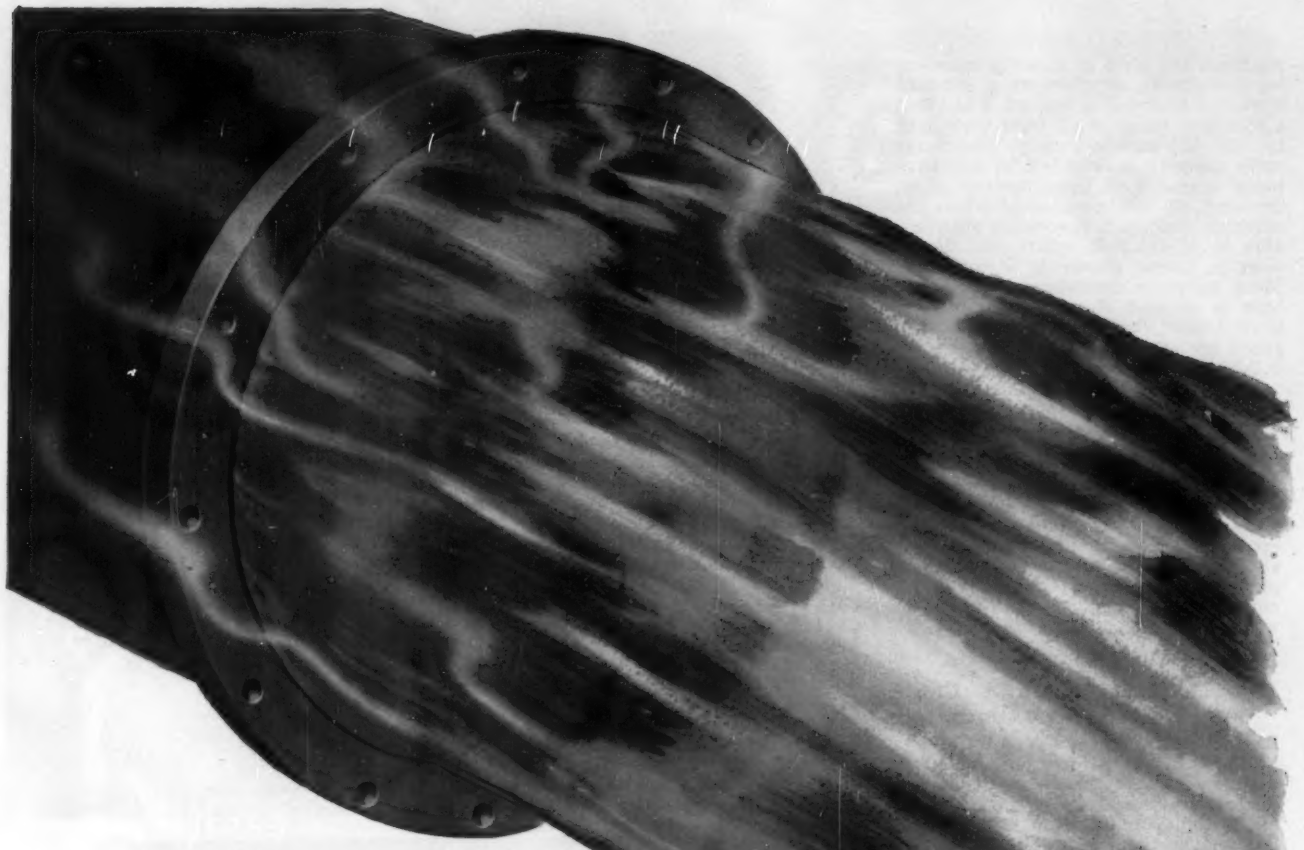
According to company, the Aerosolve Filter permits lower initial, owning and operating costs than possible with other air-cleaning devices in its efficiency range, and the only maintenance required is cartridge replacement. Initial pressure drops for the various cartridges range from 0.35 to 0.16 in. wg. The filter comes in a standard capacity of 1000 cfm, and in smaller capacities to 125 cfm. Dimensions for the permanent frame of the 1000-cfm model are 24 by 24 by 12 in. Cambridge Filter Corp.

11—END WRENCH for heavy duty pipe work

Designed with an offset handle to permit easy use on pipe in coils or against flat surfaces, this end wrench is announced for rugged duty and hard, tough pipe work. Features of the end wrench include a new-type single spring that will not hang up on small sizes and assures quicker, easier setting of jaws; an easy-action nut; improved sure-grip handle design; positive hook action; handy pipe scale on hookjaw. It is available in 8, 10, 14, and 18 in. sizes. Toledo Pipe Threading Machine Co.

17—CONSTANT LEVEL OILERS are large capacity units

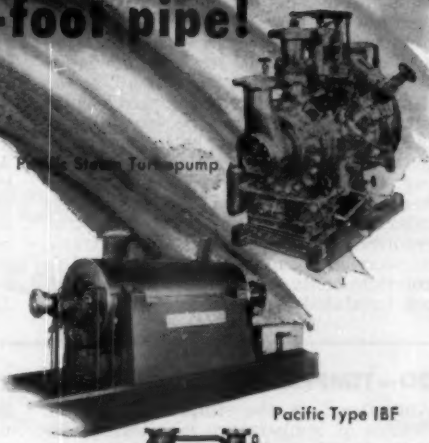
Designed to automatically maintain a constant level of oil in large ring or ball bearings chambers, pump and gear housings, these units can also be used to



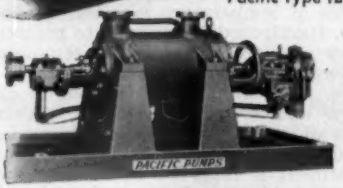
It takes a lot of water to fill a 7-foot pipe!

To bring the hot water to all the Pacific Boiler Feed Pumps placed in operation in 1953 would require a pipe 7 feet in diameter...

Today practically all of the large power generating companies throughout the United States have one or more Pacific Pumps in feed water service. Pacific Boiler Feed Pumps now operating include small vertical type units handling 47,700 pounds per hour at 710 psig discharge pressure—to very large horizontal type units handling 800,000 pounds per hour at 2430 psig discharge pressure. Bulletins 106, 109 and 118 giving details available on request.

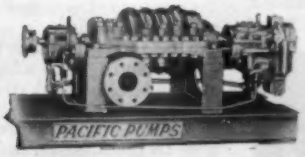


Pacific Type IBF



Pacific Type ABF

Specify **Pacific CENTRIFUGAL BOILER FEED PUMPS**



Pacific Type JBF

Pacific Pumps inc. HUNTINGTON PARK, CALIFORNIA
ONE OF THE DRESSER INDUSTRIES
Export office: Chanin Building, 122 East 42nd Street, New York
Offices in all principal cities

BF-19

For more data circle 544 on Post Card

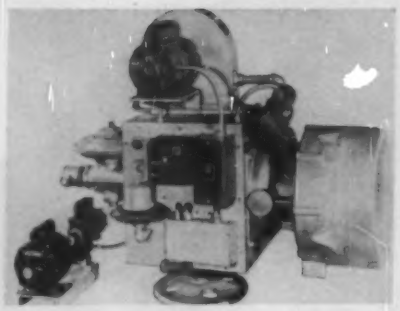
maintain the level of water in moistening equipment, or wherever a constant level in a reservoir is desired. They feed a complete range of oil from very light to 600 W, says company, and large surge capacity is provided for any back surge caused by a large amount of oil draining off the mechanism when the machine is stopped. Reservoirs are available in 10-oz, pint, quart and 2½-qt sizes in Lucite plastic or Pyrex glass. Metal parts are machined brass and the base is of cast aluminum. Joints are silver-brazed for strength and to safeguard against leakage. Bulletin 35 gives details. Trico Fuse Mfg. Co.

18—SUMP PUMP for quick removal of water, other liquids

This pneumatic sump pump is designed with extra large capacity so that dewatering can be accomplished quickly. It can be dropped in the water, and will also handle mud and raw sewage. Company says it operates on any 105 or 125 cfm compressor and it is small and lightweight. Schramm, Inc.

19—FLEXIBLE CONTROL CABLE with 5 to 24 conductors

Bronco 60 Certified Control Cable is available in Sizes 18 through 10 AWG, with from 5 to 24 conductors. The conductors are annealed electrolytic copper for flexibility and flex-life, and the insulation over them is heat-resistant type RH rubber. Singles are color coded. The outer protecting jacket is said to contain not less than 60 per cent new Neoprene by weight to provide protection against oil, grease, heat, cold, flame, sunlight, acids and practically all factors in the industrial environment which attack rubber. Name, type, size, number of conductors, voltage and other information are vulcanized into the protecting sheath. The cable is self-measuring because the branding is repeated at 2-ft intervals. It is suggested for control, recording, metering and signal transmission circuits. It can be installed in conduits or ducts, or in the open. Western Insulated Wire Co.



21—GAS-OIL BURNER is packaged unit of large capacity

The SP-890 is a self-contained fan-type combination gas-oil burner for firing rates up to 3,000,000 Btu. It is a completely packaged unit including blower, burner, oil pump with motor, built in tuyere, air/gas mixer, safety equipment, transformers, valves, regulators, filter, piping and wiring. This rotary flame burner can be used with light oil, oil or gas for automatic off-on firing of steam boilers, water heaters, air heaters, heating plants, industrial ovens and similar applications.

A snap-switch control on the side panel of the burner changes fuel automatically, company explains, and this switch sets all controls in operation for the fuel desired. Unusually clean firing is claimed to result from operation of an outside-mounted air switch interconnected with fuel controls. This switch delays opening of the main fuel valve until air pressure is at full on to deliver the correct amount of air for complete combustion. The switch also provides a safety feature in that if the air supply fails, fuel to the burner is cut off.

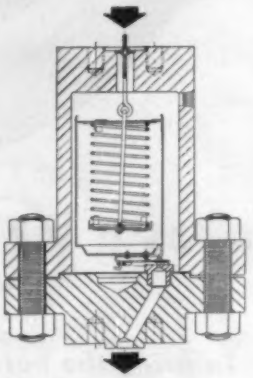
Another feature announced is positive ignition. With oil fuel, direct spark ignition is used to start the main flame. A gas pilot ignites the main flame when gas is used, and, it is noted, this pilot must "prove" itself to the electronic safety circuit before main fuel is admitted to the burner. Electronic eye and flame electrode-detectors are provided for flame-failure protection. Eclipse Fuel Engineering Co.

22—FUEL OIL ADDITIVE dissolves sludge, disperses water

In addition to dissolving sludge this additive, Sludge Solvent 32, is said to emulsify water which gets into the oil by condensation or by accident. According to manufacturer, the emulsifiers used are especially selected not to promote wetting of the tank by the water — but rather to promote wetting of the tank by oil, to keep way water away and so prevent rust. The additive acts to cause any water present to be emulsified in the oil and kept out of contact with the metal of tank, it is explained. Montgomery Chemical Co.

23—STEEL TRAP features non-collapsible open float

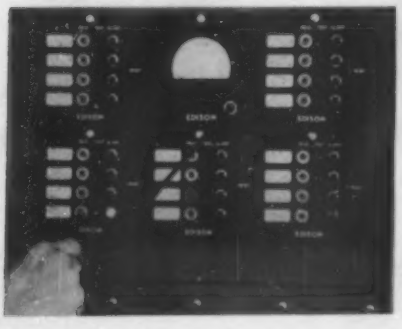
Designed for draining water from compressed air or gas systems at pressure to 3000 psig where no gas loss is permissible, this forged steel trap features a non-collapsible, spring-balanced open float which normally holds the valve closed by the weight of water in



the bucket compressing the spring. Entering condensate fills trap body adding buoyancy to the float, and this plus the spring compression then overcomes the weight of the water and bucket. The bucket floats — opening the valve and allowing condensate to discharge, it is explained, and the water sealed valve closes before all water is discharged. Its capacity at 2000 psig is 2000 lb/hr. Working parts are stainless steel. Body and cap are ASTM F-5 chrome moly steel. Inlet connections are flanged — 1 in. or 1¼ in. Outlet connections are flanged or screwed — 1 in. or 1¼ in. Armstrong Machine Works.

20—TEMPERATURE SYSTEM monitors few or many remote points

Announced as the simplest and most flexible of temperature monitoring systems, Omniguard is designed to protect a few or several hundred remotely scattered points from temperature excesses. Its simplicity, building-block design and low cost bring it within reach of many plants which formerly found such equipment too costly. Initial investment is reported to be low, the simplified wire routing affords reduced installation costs. Also stressed as a money saver is the building-block feature. Whether four or 400 points are installed, Omniguard functions as a complete system. An original installation of four points can be increased to any multiple of four points, it is pointed out, and without affecting existing units or wiring. A further advantage claimed is that Omniguard monitors without scanning, so that no point is left unguarded.

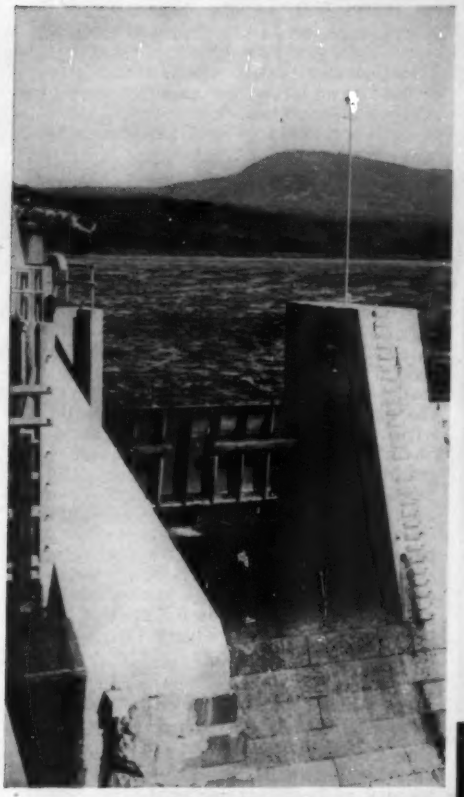


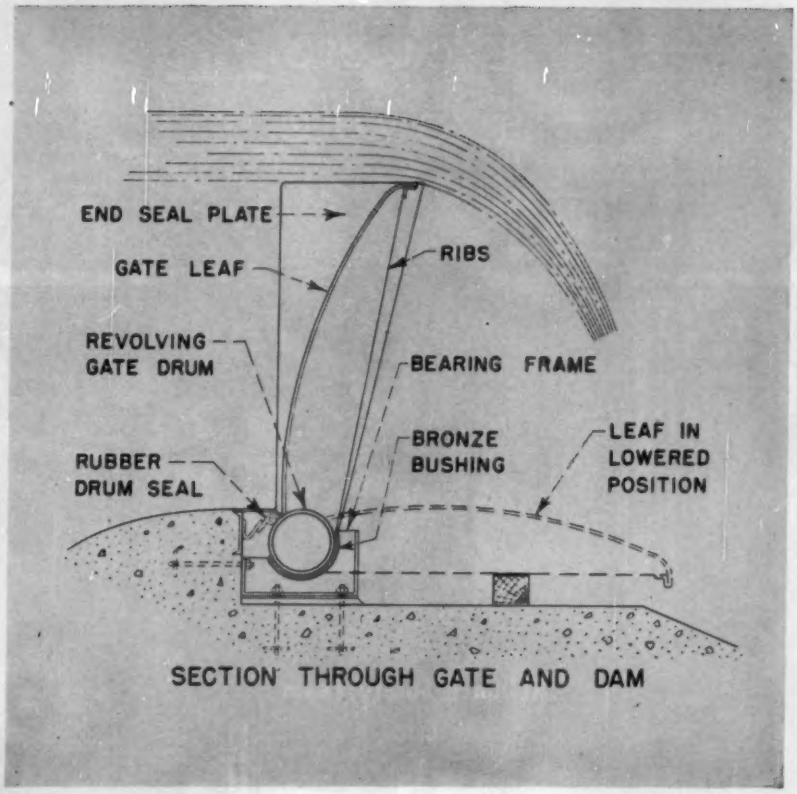
Omniguard operates without moving parts. Each unit is self-contained and can be removed from the panel without disconnecting any wires; all connections are made to a quick disconnect plug that is part of the panel. Omniguard uses resistance temperature detectors adaptable to installation in bearings, oil lines, air ducts, chemical tanks, and for applications from −100 to 1350 F. It is designed to automatically sound a warning when a given point or points reach a temperature considered critical. One indicator unit serves as many monitor units as needed. The jack cord can be reeled out to plug into any point when a temperature reading is desired. Instrument Div., Thomas A. Edison, Inc.

24—UNDERFLOOR SYSTEM for distributing electrical power

Powerduct is announced as an underfloor distribution system offering concealed, large-capacity raceways with unlimited access possibilities. It is furnished in 10-ft lengths and is installed with junction boxes, couplings, and self-leveling supports on form, slab or fill prior to pouring the finished floor. In many cases, Powerduct can be installed to modernize existing buildings.

Pre-set inserts in the duct provide evenly spaced outlet points. The duct has 17 sq in. cross sectional area which will accommodate cables up to 500,000 circular mils. Other features of the system include 14-gage steel construction, welded seam and corrosion protection. Complete systems are available includ-





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Raising the water level is often the most economical way to meet increased demands on water and power supply. This problem can be quickly and economically solved on existing dams with a Bascule Crest Gate. Advantages of the SMS-Bascule are the speed and ease of operation for flood control and for sluicing away debris and ice.

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ing junction boxes, ells, supports, couplings, caps, etc. Only standard electrician's tools are necessary for installing. Manufacturer says Powerduct can also be used as an underfloor raceway to give protection or permit future installation of such services as water, gas and coolants. Walker Bros.

25—PRESSURE GAGE offers good visibility, easy reading

A bifocal pointer and high visibility dial are utilized in this 19½-in. Bourdon pressure gage to permit simplified reading from a distance or close to the indicator. Pointer zeroing is done with a special locking knob, claimed to provide stable zero settings over 20 per cent of the dial range. This 19½-in. indicator, with an equivalent linear length of 55 in. is finished in white with black graduations, is housed in a grey case, and has a clear plastic dial covering. When used with company's load cells, this gage is claimed to provide accuracy of ±2 per cent of load range. It is available in ranges to 100,000-lb capacity. Models can also be supplied with special scales and other modifications for special applications. The A. H. Emery Co.

26—HEAT EXCHANGERS, semi-standard, optional features

This new line of semi-standard heat exchanger units is designed to meet a wide variety of heat-transfer problems. Several optional design features may be specified. For example, nozzles may be of any size or in any location required by the installation. Units may be had with or without expansion joint. They are readily available in stainless or carbon steel, and other alloys may be specified though a longer time may be required for delivery.

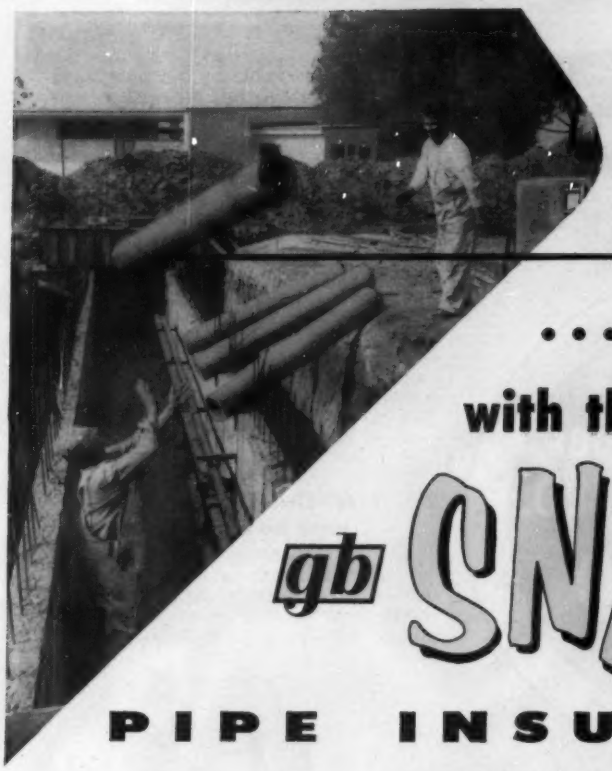
In these new semi-standard units, thickness of tube sheets is ⅞ in. and up, and thickness of bonnets and channels is $\frac{3}{16}$ in. The units are designed for pressures to 150 psi. Standard shell diameters are 5, 6, 8, 10, 12, 14 or 16 in. available in various lengths. Construction may be single pass, two-pass or four-pass; tube diameters are ⅝, ¾ or 1 in. Downingtown Iron Works, Inc.

Reader Service Cards on pages 115–116 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

27—RESISTANCE METER measures insulation resistance

This 10 kv insulation resistance meter is designed for measuring degrees of insulation resistance, polarization index, and leakage current. It is portable and provides for making of d-c over potential tests. Said to be ideal for measuring of insulation quality of equipment such as rotating electrical machinery, windings, transformers and associated equipment with large dielectric capacities, the meter is designed to measure insulation resistance to 200,000 megohms at 10 kw.

When utilized for d-c testing, it reveals



It floats through the air . . .

. . . and goes on the pipe . . .

with the greatest of ease!

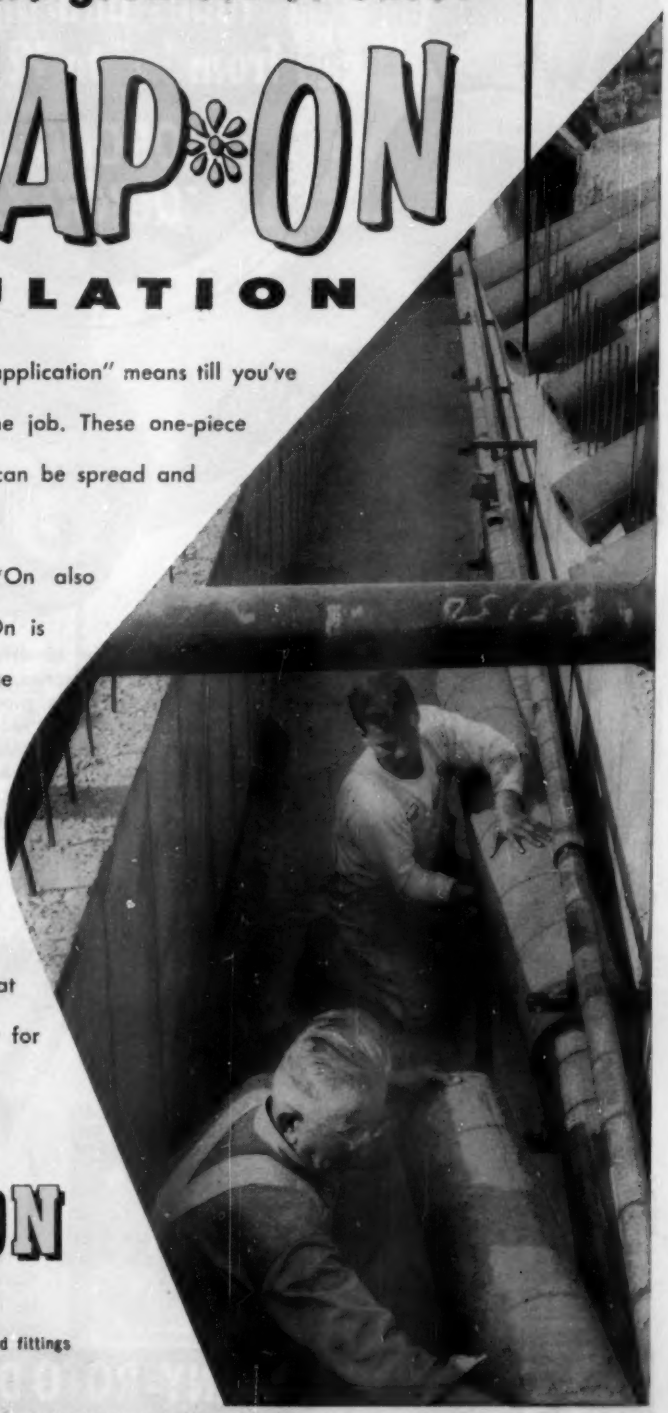
gb SNAP*ON

PIPE INSULATION

You really have no idea what "quick and easy application" means till you've seen G-B Snap*On applied to hot or cold piping on the job. These one-piece molded cylinders of fine glass fibers, in sections 6' long, can be spread and snapped on the pipe in as little time as it takes to tell.

As the photo at upper left indicates, Snap*On also reduces handling time to an absolute minimum. Snap*On is so light that it can easily be tossed and caught with one hand. If the worker should drop it, no harm is done—for Snap*On is tough and resilient. And as for "clean-up" time, there's nothing to clean up.

Add to these time-saving conveniences the fact that G-B Snap*On delivers maximum thermal efficiency—*more* heat savings per insulation dollar. Consider, too, that Snap*On is as *permanent* as glass itself. Then write today for the full story on this revolutionary pipe insulation!



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ROTOJET Model C-526 Air-driven Motor with pivot head and universal joint.

ROTOJET Model C-525 Air-driven Motor with swing-frame head and universal joint.

ROTOJET Junior Model S32 Air-driven Motor, universal joint, cone cutter.

ROTOJET Junior Model C434 Air-driven Motor, flexible coupling, expanding brush.

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Ave. Newark 1, N. J.

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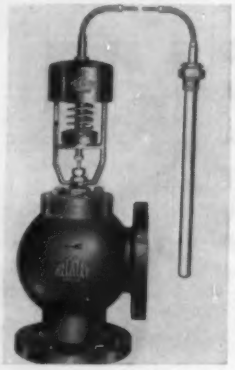
faults not observable by a-c tests, says manufacturer, and thus provides a complete picture of insulation quality. It is also suggested for production testing or laboratory checking. Featuring resistance reading directly for specified voltage, and d-c voltage output continuously adjustable over a range of 0–10,000 v d-c of either polarity, the meter is claimed to handle capacitances normally found in large, high voltage apparatus. It includes a built-in voltage stabilizer plus a high sensitivity and readability of 0.02 micro-amperes per scale division on a low range of 3½ in. scale. It requires a power supply of 115 v ± 10 v, 60 cycles a-c, fused for a 20 amp start. The new product weighs 110 lb net. General Electric Co.

28—TEMPERATURE REGULATOR may be mounted directly

Type T Temperature Regulators may be mounted directly on heat exchangers, instant water heaters, etc., having inlet connections on top — permitting simplified piping and installation. The



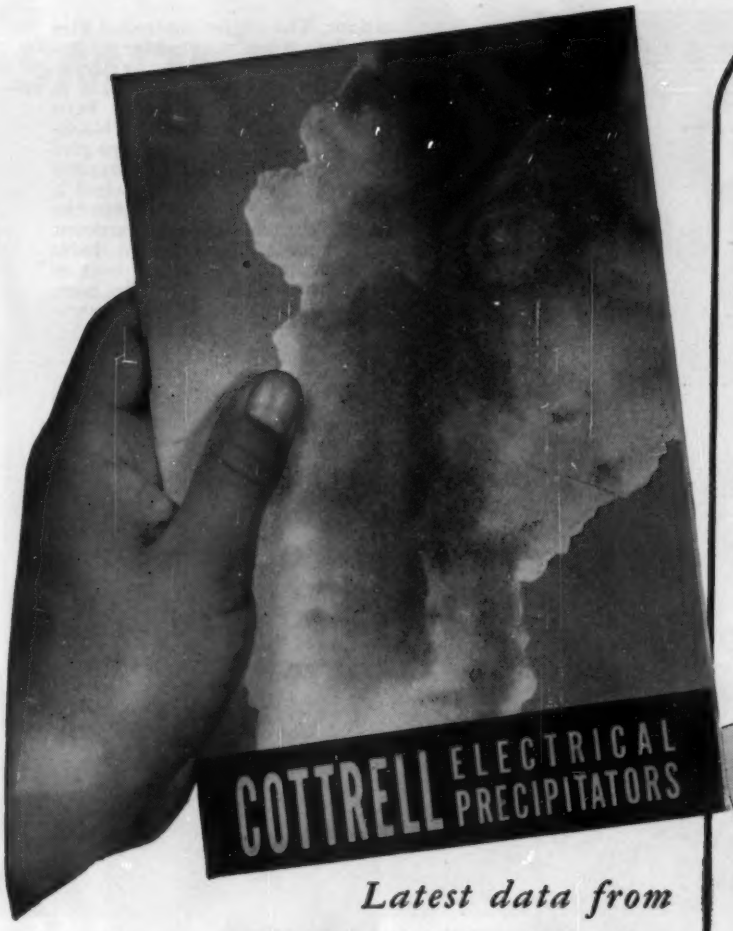
regulator has renewable wearing parts of stainless steel or bronze. An over-run device for protection of the thermal element in the event temperature at the bulb exceeds the range of the regulator is another feature announced. A two-ply bellows is used in the thermal unit for added power and longer life. Body is bronze or semi-steel. It is available with screwed connections in sizes from ½ to 2 in. and with flanged connections in sizes from 2 to 8 in. All ½ to 4 in. sizes are spring loaded; sizes from 6 to 8 in. are weight loaded. O. C. Keckley Co.

29—PORTABLE GENERATOR is easily carried unit

Light enough to be carried by one man, this generator is designed to put out 1500 w of electricity — enough to operate small tools, floodlight, deep freeze units, electric pumps, and similar electrical equipment. A 4-cycle, direct-drive, 3-hp gasoline engine runs the generator. Because of its automatic rewind starter and two built-in sockets you can plug in and have it running in seconds, says manufacturer. It is available in a d-c model weighing 97 lb; and an a-c model, 107 lb. Master Vibrator Co.

30—HEAT TOOL burns low cost propane fuel

The Fire Gun, a portable hand-operated heat tool that burns propane with heat range of 4000 to 117,000 Btu per hour, is intended for small or large heating



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- Various Shell Constructions (steel, concrete, brick, etc.).
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. . . and many other helpful facts on Cottrell design and operation.

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Do you have operations in your plant where gas-laden suspensions, wet or dry, are a problem? Such suspensions may be dropping on surrounding property, causing nuisance difficulties. Or perhaps important values are being lost in stack gases that can be profitably recovered. Whatever the nature of your recovery requirements, you will find this 40-page Cottrell booklet of great help. It contains up-to-date data on the latest advancements in the electrical precipitation field – prepared by the organization that pioneered the commercial application of Cottrell Electrical Precipitators almost a half century ago and has consistently led in new Cottrell developments.

A copy of this data-packed booklet will be sent free to engineers and other executives interested in recovery processes. Send your request to our nearest office.

For nearly 50 years Western Precipitation has carried on a continuous research and development program on Cottrell Electrical Precipitators, Multiclone Mechanical Collectors and other types of recovery equipment. We are not affiliated with any other company in the electrical precipitation field except our wholly owned subsidiaries, International Precipitation Corporation and the Precipitation Company of Canada, Ltd. We are equipped to serve you anywhere in the United States, Canada, and throughout the world!

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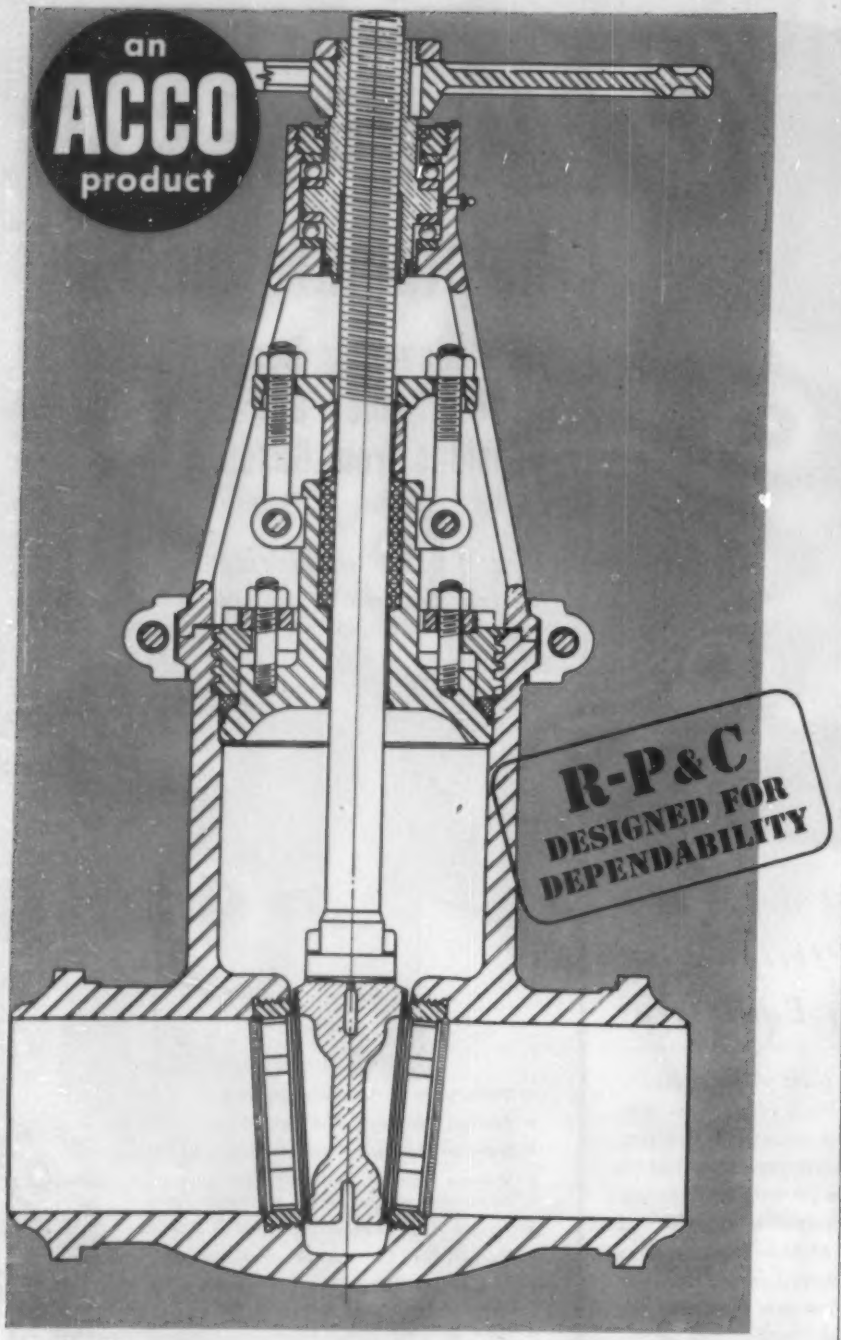

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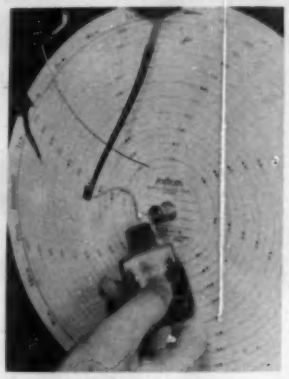
applications. The trigger-controlled Fire Gun is declared ideally suited for soldering, tinning, brazing, pre-heating, thawing, plasticizing and paint removal.

The 3650 F flame is said to burn clean with no carbon deposit or "blackened area" because the burner tips give complete combustion of the propane using oxygen from the air. This tool is also said to operate at about 1/10th the cost of many torches for same amount of heat. The basic Fire Gun kit includes a heat concentrator tip, a high heat or blow torch tip, a soldering iron tip, hose, regulator, pressure gage and steel carrying box. Fire Gun Sales Corp.

31—RECORDER INK comes in squeeze-bottle dispenser

This general purpose ink, Type 1500, is offered for use with company's industrial recording instruments. Formulated to produce a sharp record of a process variable, the ink is described as containing no sediment, as non-clogging, and as



fast-drying without feathering the chart. It is rated for high temperature and, according to manufacturer, can also be used down to zero F. The 1-oz polyethylene squeeze bottle has a plastic capillary tube-and-filter assembly designed to enable user to pinpoint a precise quantity on the pen without dripping. Box pens can be tube-filled through the point and need no additional priming before use. The ink is available in red, violet, blue, green and black. The Foxboro Co.

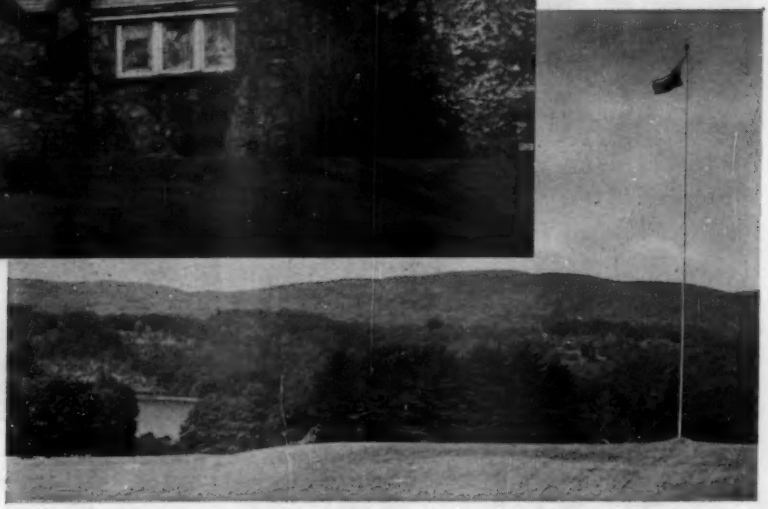
32—FAULT INDICATOR signals power failure

The Silent Sentry Line Fault Indicator is announced as a compact low-cost electro-mechanical assembly that quickly indicates a fault condition on power lines. Designed to work in all weather conditions, it is permanently installed at spaced points on transmission lines throughout the system. When a power failure occurs, servicemen visually inspect the spaced indicators for a flag signal, which indicates the trouble area.

No further tests are required, it is explained, no line disconnects are necessary to isolate the trouble area, and operation of related systems leading from the substation will not be disrupted. As soon as the trouble has been corrected, the device resets itself automatically to a normal position. The indicator is mounted by means of a hot line stick. The mounting arrangement is such that the line indicator passes through the yoke-shaped magnetic cores of the unit. The device operates in all weather. R. G. Genzlinger, Inc.

SMOKELESS OPERATION...

TAYLOR, OF COURSE!



Taylor stokers at the Hudson River State Hospital, Poughkeepsie, N. Y., assure freedom from stack nuisance for this modern institution comprising 80 buildings and 890 beautifully developed and landscaped acres. Pictured above is one of the chapels; at right, a view from steps of the Main Building.

Taylor multiple retort underfeed stokers are today's first choice with state institutions, colleges, hospitals, and heating plants in the heart of cities. This is only natural, for properly engineered Taylor Stokers abolish the stack discharge nuisance once and for all—without costly dust collectors and consequent draft losses!

Furthermore, Taylor's smokeless operation is proof of superior combustion and fuel economy. Wet coals and low grade coals are no problem. Refuse is a desirable by-product instead of an added expense. And Taylor can handle widely varying loads with long-continued low steaming rates ...load variations of 20 to 1 or more are common.

The Taylor Stoker is backed by an organization with reliable service stations in Philadelphia, Dayton and Detroit...Whether your new boiler must deliver 20,000 or 500,000 lbs. of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us for a copy of free booklet giving full information about Taylor, the completely modern stoker with the old, old name. American Engineering Company, 2408 Aramingo Avenue, Philadelphia 25, Pa.

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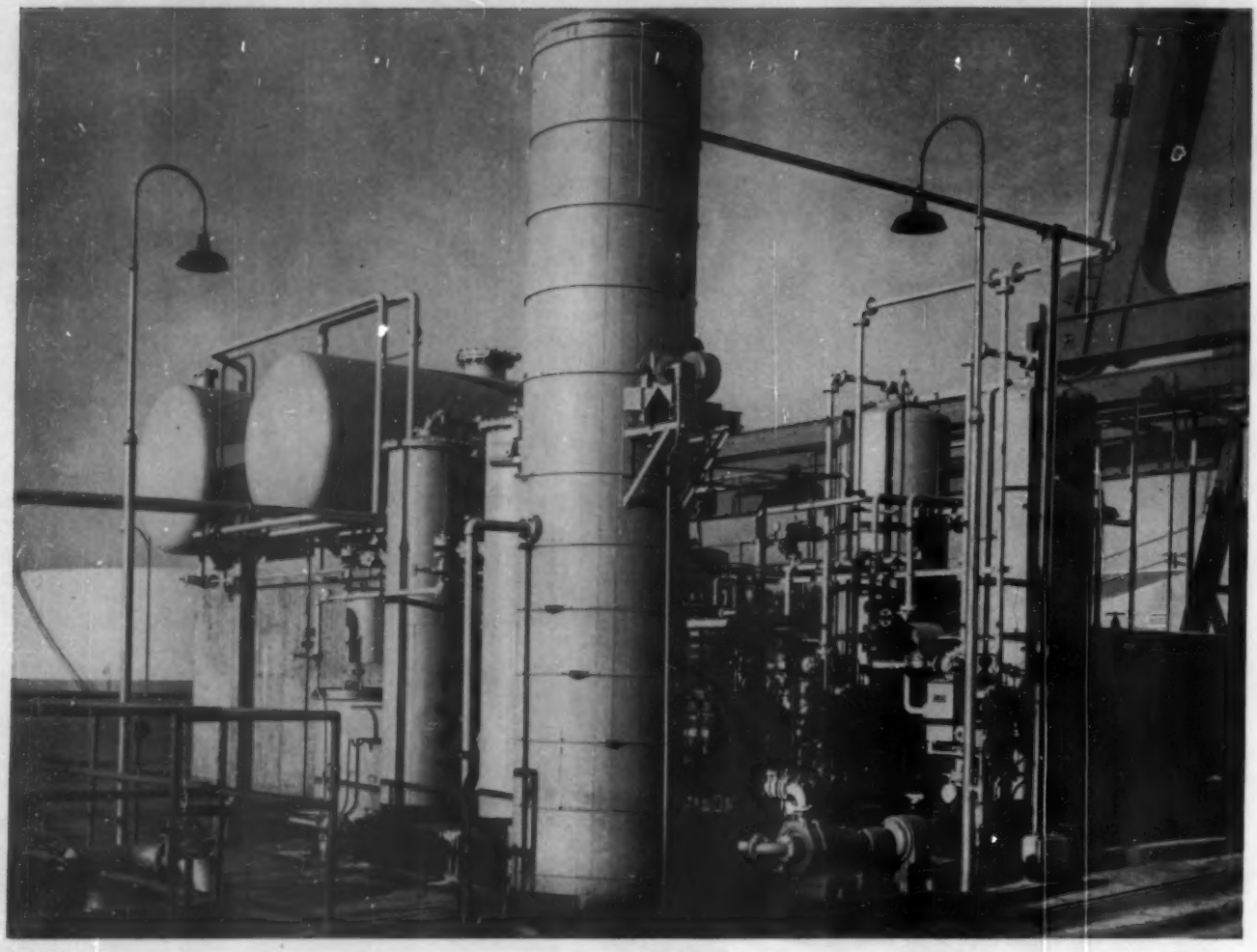
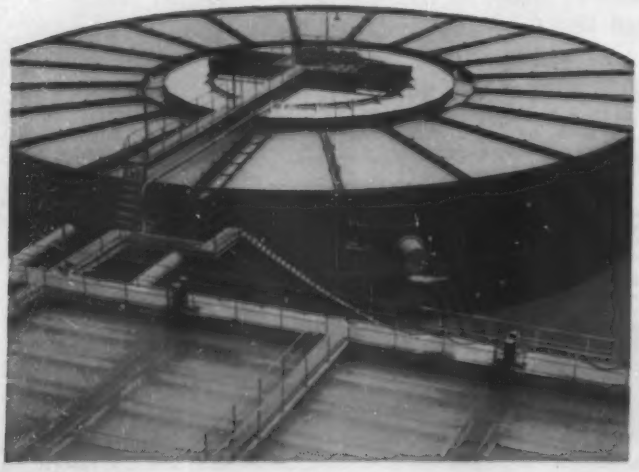
3 SOLUTIONS FOR YOUR BOILER FEEDWATER PROBLEMS



1. CATEXER® and ANEXER® Demineralizing Plants: Pioneered by INFILCO, these demineralizing and silica removal plants, operating on the ion exchange principle, provide the low solids and low silica content water so necessary to the satisfactory operation of very high pressure boilers and turbines. They afford five major advantages: (1) improved make-up quality, (2) adequate make-up supply regardless of station electrical load, (3) reduced overall operating costs, (4) lowered maintenance costs and (5) lower labor costs.

2. ACCELATOR® Treating Plants: The "ACCELATOR" treating plant with appropriate chemical feeding equipment and auxiliaries affords in many cases a satisfactory means of treating feedwater for low pressure boilers or for pretreating feedwater for higher pressure boilers. They have a proven record of flexibility, ease of operation and chemical economy.



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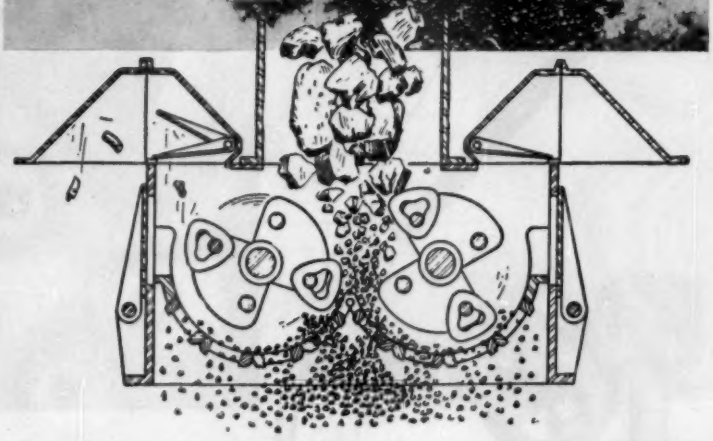

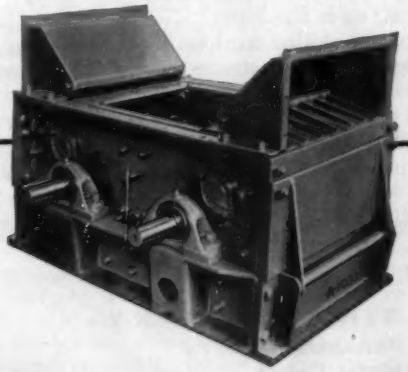

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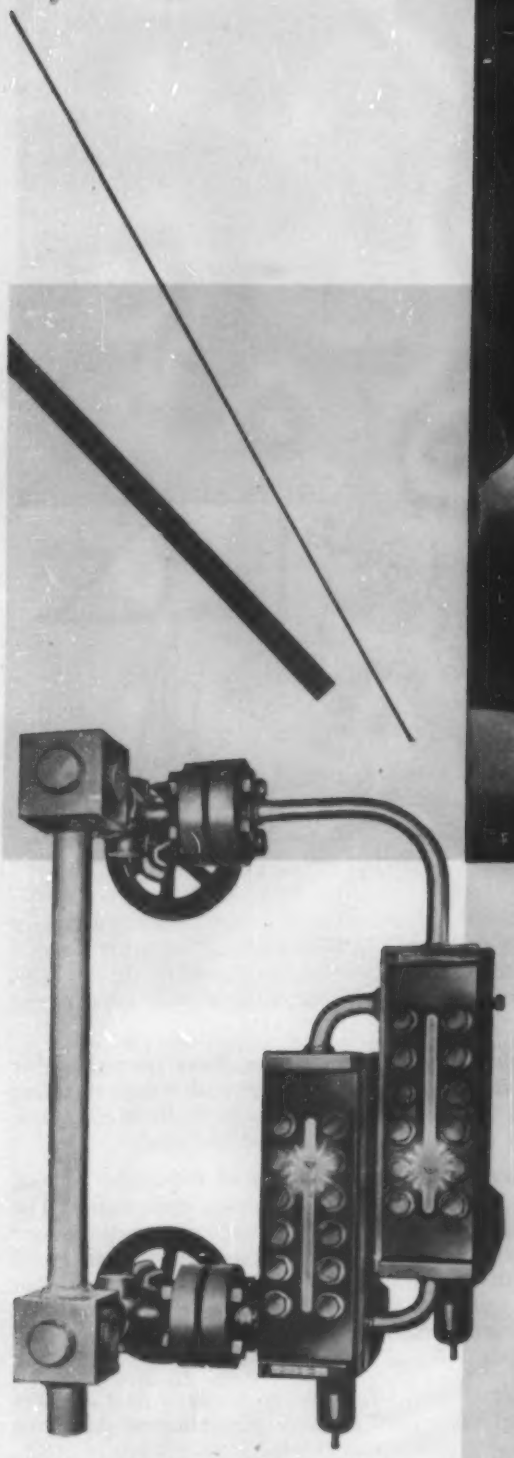

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The man is typical of the skilled workmanship that goes into every Yarway gage, blow-off valve, steam trap or other product —workmanship that makes no compromise with quality.

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EVALUATION OF CRITICAL PARTS PROTECTION REQUIREMENTS

(The Evaluation is based on the failure of a part which requires the longest repair time such as armature coils)

	NO MAJOR PARTS STOCKED	ARMATURE COILS STOCKED	COMPLETE ARMATURE STOCKED	COMPLETE MACHINE STOCKED
REPAIR TIME	10 days to make coils X	6 days to rewind armature X	7 hours to install new armature	3 hours to replace motor
TOTAL DOWNTIME COST	$168,000	$100,800	$4,900	$2,100
COST OF PARTS PROTECTION	0	Coils: $4,664	Armature: $25,600	Motor: $46,000
COST OF REPAIR	$12,730	$5,900	Installation: $850	Installation: $360
TOTAL FAILURE COST	$180,730	$111,364	$31,350*	$48,460*

Here's a chart showing how to figure out what critical parts for any particular machine should be kept in stock to give lowest overall cost in case of breakdown

What Electrical Spares Should We Carry?

With no spares, breakdowns cost too much. Carrying a complete machine as spare is also too expensive. Cheapest way is to carry some critical parts. Here's how to determine what spares to buy

By L. A. BECK *

AS A MACHINE GROWS OLD, and the prospects of failure increase, it is usual to take precautions to minimize the bad effects of a breakdown. At one extreme you may carry no spares at all, while at the other you could carry a complete new machine in stock. Both these extremes are expensive. With no spares, though the cost of protection is nil, the cost of repairs and lost production time would usually be prohibitive. With a complete machine held in stock, repair time and production losses would be low in case of breakdown, but the cost of carrying a complete machine in stock would also be very heavy.

In practice, the most economical arrangement is usually found to be somewhere between these two extremes, i.e. an arrangement where a certain number of major parts are held in stock, so that repairs can be made quickly, and yet there is not too much money tied up in spares.

Chart above shows how to evaluate the best arrangement for any piece of equipment. In order to show how this chart is used, we have worked out an example for a 500 hp slow speed d-c motor on a machine critical to production at a large western paper mill. To determine how much protection is required follow these steps:

1. Calculate repair time under the following conditions assuming major failure:
   - A. No critical parts stocked
   - B. Some critical parts stocked (such as coils)
   - C. All critical parts stocked (such as complete armature)
   - D. Complete unit stocked
2. Determine cost of repairs and inventory for each of the possible conditions.
3. Total this information to determine the total "failure cost."
4. Analyze total cost for each condidition to determine what you must stock to protect the equipment.

Referring to the chart herewith, it will be seen that the problem is to determine how much an armature failure will cost the company, assuming production outage is $700 per hr.

By this type of evaluation it will be seen that the most economical arrangement is to stock a complete armature. Having obtained the most critical part, management may then decide to replace the armature during a planned outage when there would be little or no loss of production. Just when to schedule an overhaul during a planned outage has to be decided separately for each piece of equipment, and requires close cooperation between maintenance and production departments to reduce outage time to a minimum. Based on periodic inspection and test, the probability of failure can be determined, considering such things as age, duty cycle, surges, overloading, etc.

The methods of a-c and d-c testing to determine the probability of failure is too large a subject to cover here. Usually, insulation resistance measurements are made with a megger or ohmmeter. Accepted values of insulation resistance for safe operation should be obtained from the motor manufacturer or the insurance company that insures the equipment.

Another big advantage of planning an outage is that many minor repairs can be done at the same time. With an emergency shutdown, there is seldom time, either to get together the parts and equipment for the small jobs, or even to do the small jobs themselves. Thus the small jobs get neglected. A small fault neglected seldom gets better and eventually can grow big enough to cause a major outage on its own.

* Manager of the Apparatus Service Shop, Pacific Southwest District, General Electric Co., Los Angeles, Calif.

Table of approximate times required for analyses conducted by different methods

ELEMENT	TIME VS. METHOD OF ANALYSIS				
	CHEMICAL ANALYSIS	SPECTRO-PHOTOMETER	FLAME PHOTOMETER	POLARO-GRAPH	SPECTRO-GRAPH
Al	5 hours				
Fe	5 hours				
SiO_2	8 hours	3 hours			
PO_4	4 hours	90 minutes			
CrO_4	2½ hours				
Organic	2½ hours				
Na	6 hours		30 minutes		
K	6 hours		30 minutes		
Zn	3 hours			1 hour	
Complete Analysis	16 hours				2 hours

How to Identify Steam-Water Cycle Deposits

By H. E. EIGNER*

TREATMENT of water used in power plant equipment has been practiced for many years to prevent scaling, corrosion, carryover, embrittlement, and micro-biological growths. Present knowledge of the subject permits a high degree of predictability of results when all of the necessary information is made available. In the absence of complete or correct information, however, or where operating controls or procedures permit deviations from the recommended ranges, results may be obtained that are not completely satisfactory.

These results are usually represented by the formation of scale or sludges in components of the steam-water cycle.

Most deposits are composed of crystalline compounds identical to minerals that have been thoroughly classified according to causes of formation. If the compounds can be properly identified, their causes of formation are known and it may be possible to prevent further deposits by correction of certain conditions.

Chemical analysis of deposits has long been a method of identification. This method determines the relative amounts of the individual elements in a deposit. However, it does not provide positive identification of the crystalline forms in which the elements are combined.

A number of more recent methods of analysis have been developed which utilize laboratory instruments for more precise analysis of certain elements or permit positive identification of compounds. The instruments now available in a well equipped laboratory include the spectrophotometer, flame photometer, polarograph, petrographic, biological and metallurgical microscopes, X-ray diffraction apparatus, and the spectrograph.

The analysis of a particular deposit can be accomplished through use of any one or a combination of the above methods or instruments according to the amount of information

*Water Conditioning Section, Allis-Chalmers Mfg. Co.

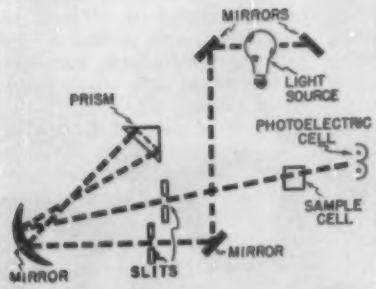


Fig. 1. Schematic diagram of spectrophotometer, showing theory of operation

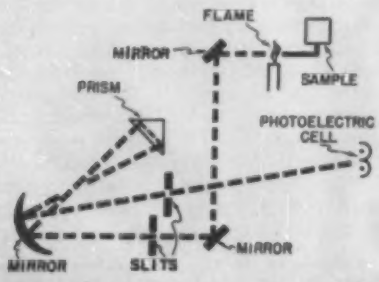


Fig. 2. Schematic of a flame photometer

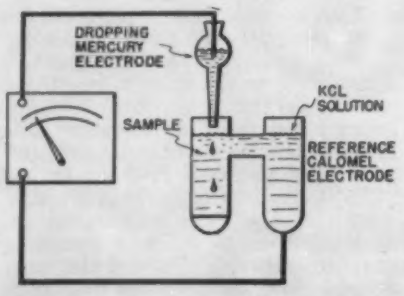


Fig. 3. Schematic of a polarograph cell

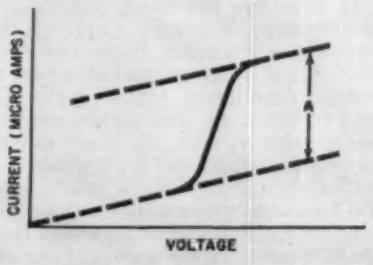


Fig. 4. I-E curve of a polarograph cell

Fig. 5 (Left). Spectrophometer with a flame photometer attached determines silica, phosphates, sodium, and potassium.

Fig. 6 (Right). Polarograph in the background, flame photometer in foreground

required. If only identification of the crystalline forms present in the deposit is desired, the petrographic microscope might be used. In the hands of a competent analyst, the more normal crystalline forms present may be identified and an approximation of their amounts given within a few minutes. A positive identification of all the crystalline compounds and an indication of the relative amounts, grain size and orientation of the crystals may be obtained through the use of the X-ray diffraction apparatus. Total amount of time required for a complete analysis by this method could take up to four and one half hours.

If more precise information is required concerning the percentage of each of the compounds found, complete chemical or further instrumental analysis is necessary.

A complete chemical analysis of a deposit can take up to 16 or more hours and still not determine every element. Several of the normal constituents of deposits can be determined only by instruments while others can be determined more quickly and accurately. Spectrographic analyses may take the place of chemical analysis in many cases since all of the metallic ions present are identified with semi-qualitative results if desired. The total amount of time required for this method of analysis is only about two hours.

Approximate times required for analysis of a deposit by the various methods is given in the Table. A description of the six instruments currently available for deposit analyses and their use follows.

The spectrophotometer when used for deposit analyses determines silica and phosphates. When mixed with certain reagents and dissolved in water these materials develop a color proportional to the amount of the chemical group present. By passing a beam of light through the solution and measuring the amount transmitted, a reading is obtained that can be converted to a definite amount of the chemical group.

It has been found that a beam of light of a single wave length produces the best results. The schematic diagram (Fig. 1) shows how the commercial instrument reflects light from a tungsten filament bulb through a series of mirrors, a prism, and slits before the beam passes through the solution to be tested. A photoelectric cell registers the amount of transmitted light by converting it to electric current. Calibration curves are then used to convert the reading to concentration of chemical.

Sodium and potassium are determined most accurately through use of the flame photometer. This instrument is similar to the spectrophotometer except that a solution of the sample is drawn into a flame which serves as the source of light. The intensity of the color of the flame is proportional to the concentration of the specific metallic ions in the solution. Fig. 2 shows diagrammatically how the beam of light passes through the instrument and is finally measured by the photoelectric cell. Calibration

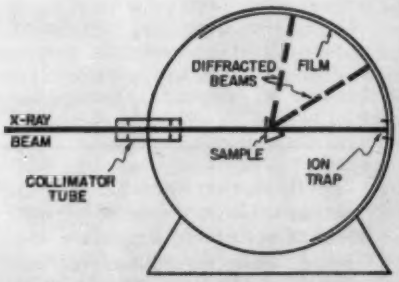


Fig 7. Diagram of X-ray diffraction apparatus which registers pattern on film

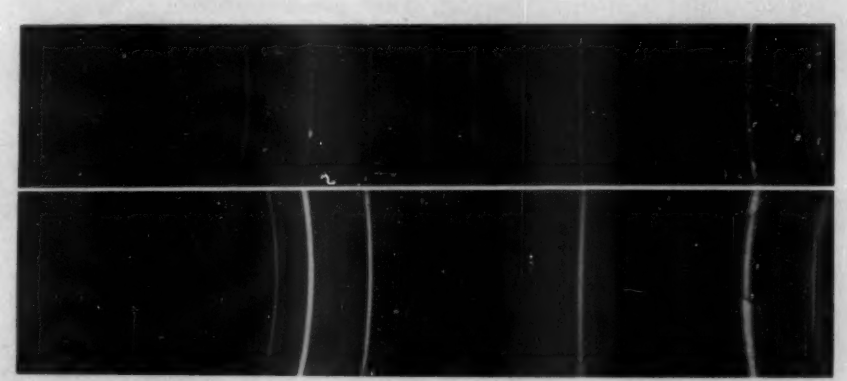


Fig. 8. Specimen X-ray pattern and known mineral pattern are compared visually

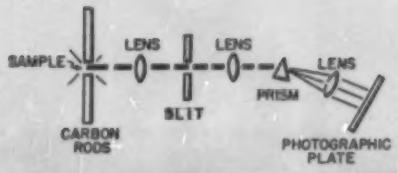


Fig. 9. Spectrograph (below) shown with its schematic (left) makes prismatic pattern based on metallic ions in sample

Fig. 10 (Left). X-Ray diffraction unit

Fig. 11 (Above right). Metallograph is similar to optical microscope with camera

Fig. 12 (Right). Petrographic microscope identifies sample from its crystal habit, which varies with the constituents

curves again convert readings on the instrument to percentages of chemicals.

When the amount of zinc in a deposit needs to be known, it can best be determined by use of a polarograph. This instrument measures the amount of current and voltage required to cause a metal in a solution to begin to plate out on the cathode. When this point is reached, the current rises rapidly and the increase is proportional to the amount of metal in solution.

Fig. 3 shows the way this is accomplished in the polarograph. The solution to be tested is placed in a cell containing a dropping mercury electrode which acts as the cathode. This cell is connected to a reference calomel electrode which serves as the anode. When current is allowed to flow, the instrument automatically starts through a definite voltage span. The current and voltage are continuously recorded on a chart and when the decomposition potential is reached, the rise in current is automatically recorded. Measurement of this rise can then be converted into concentration of solution.

Fig. 4 shows the curve drawn by the instrument and the measurement that permits determination of concentration.

The normal biological or optical microscope is used in the identification of algae and slime that may be contained in a deposit. The petrographic microscope (Fig. 12) differs from the optical microscope only in that it is equipped with a graduated rotating stage and polarizing prisms. It is used to study and identify the crystal formations in a deposit.

The metallurgical microscope (Fig. 11) is similar to the optical microscope except that it has an attached camera. It is used to study the microstructure of metals as in cases of boiler tube failures where over-heating of the metal or intercrystalline corrosion is suspected.

Identification of the crystalline form in which compounds have been deposited can be accomplished through use of the X-ray diffraction apparatus. Use is made of the knowledge that each crystalline inorganic and a few organic materials reflect X-ray beams in a specific pattern because of the way the planes of the crystals are joined.

Fig. 7 shows how a powdered specimen is placed in the path of the X-rays. The reflected or diffracted beams are registered on a photographic plate. Comparison of the developed plate, such as shown in Fig. 8 with standard patterns of various crystalline materials permits identification of minerals in the deposit.

Identification of metallic ions together with a semi-quantitative report of their concentration may be accomplished by a spectrographic analysis. The spectrograph works on somewhat the same principle as the flame photometer. Metallic ions excite flames of definite color or wave length. The intensity and wave length of the colors given off by a sample can be used to determine the metallic ions present and their relative concentrations.

The diagrammatic drawing (Fig. 9) illustrates the action of the spectrograph. The characteristic wave length given off by the sample in the arc or sparking device are separated by a prism and recorded on a film.

Today the analytical instruments just described are making possible swift but accurate and complete identification of deposits from steam-water cycles.

IF YOU want to keep this article, or any other in the issue, do not tear it out of the magazine. Instead, write the editors for an extra set of pages. Preserve the issue for others.

Non-Sparking Tools Can Make

Hammers and tools of bronze, copper, aluminum, glass, and even rubber can strike sparks off aluminum-painted iron under certain conditions. These sparks can ignite explosive vapors. Every power engineer should understand when non-sparking tools may not be safe

IF RUSTY IRON IS painted with aluminum paint and then heated for some time to a temperature of 300–400 F, it is possible to produce sparks from the painted surface by striking it with a hammer or tool made of steel, tinned iron, aluminum alloy, glass, brick, transite, hard rubber, carbon, copper and bronze. One practical example, of concern to power engineers, would be uninsulated steam equipment in a location subject to explosive vapors. Such equipment would obviously be dangerous if it were painted with this type of paint and were liable to be struck by any of these materials.

What Makes a Spark?

Experiments made by various organizations, both in this country and in England, have shown that the sparking is produced by a thermite reaction, initiated under the heat of impact, between the aluminum and the iron oxide when they are forced into intimate contact by the striking hammer or tool.

Before the rusty plate and the paint have been heated, and assuming the paint film is not cracked, it is impossible (with the exceptions described later in this article) to strike sparks off the paint, because the paint binder acts as a kind of lubricant, lowering the temperature at the point of impact, and also preventing the iron oxide and aluminum from being forced together. Prolonged heating of the paint, however, at high temperatures, causes the binder to oxidize, thus destroying its cooling and lubricating properties and so eliminating its preventive role. This explains why sparks can be produced by such a variety of materials, since the material of which the hammer is made doesn't matter. The hammer's function is to provide impact between the aluminum and iron oxide and provide friction. The rest is done by the iron and aluminum quite independently of the material of the hammer. This also explains why hammers made of wood or leather will not strike sparks. They are too soft to tear the paint and to cause pressure and heat.

Once the plate has been heated, sparks can be struck from the paint whether it is hot or cold. The binder has been destroyed by the heating, and even if the plate cools down, the binder is still useless and the paint dangerous.

If the paint film shrinks and cracks in the cold, sparks can be obtained, even though the painted steel has not been heated since it was painted. If the film does not shrink and crack (as, for example, a linseed oil film does not) sparks cannot be obtained until the metal has been heated and the film cracked. But, once the film has been cracked, sparks can be produced by striking the steel even when cold.

Permanent protection of hot, aluminum-painted surfaces requires the complete separation of the aluminum flakes and the iron oxide. Until a vehicle is found which is not eventually destroyed when subject to high temperatures, the only safe procedure to follow, where production of sparks may be a hazard, is to free the surface to be painted of all iron oxide, either by pickling, sandblasting, or other treatment, before applying the aluminum paint. However, after some time, it is possible that rusting could take place under a cracked paint film and so give rise to a dangerous state.

The effect of rust was shown rather vividly in an experiment in which a rusty steel plate was heavily sandblasted to provide a clean surface and was then painted with aluminum paint. The plate was then placed in a furnace at 400 F, and heated for nearly a week. When taken out of the furnace, and struck with a bronze tool, no sparks could be produced. The same lack of sparking occurred when the paint was applied to white brick and to an aluminum alloy plate which were also heated for prolonged periods at 400 F. However, it was possible to produce sparks on any of these surfaces by striking them with a piece of rusty steel, and it was also found that if a small amount of iron oxide was mixed with the aluminum paint before applying it to the brick surface, sparks could be produced when it was struck.

Before describing some of the tests on which these conclusions are based, we should mention a very dangerous paint, from which large sparks can be struck when the paint is cold and without subjecting it to any heat treatment at all. These paints are quick-drying cellulose paints, usually applied by spray gun, and they usually consist of a cellulose ester (nitrocellulose) vehicle, dissolved in a volatile solvent such as amyl acetate. Such paints also contain a plasticizing compound to render the dried paint film pliable and non-flaking. Commercially produced paints of this kind usually contain resins, plasticizers, and solvents, such as ketones, esters, hydrocarbons and alcohols, which together appear to make it safe if it has had no heat treatment, though it becomes dangerous in the same way as oil base paints if it is heated to 570 F for 24 hrs. However, if there should be on the market any paint which consists solely of a suspension of aluminum powder in nitro-cellulose and amyl acetate it should be regarded with grave suspicion as being likely, if applied to rusty iron, to give, without heat treatment, very dangerous sparking.

Tests

In tests carried out by the British Safety in Mines Research Board, a cubical expansion chamber of 8 cu ft capacity was used. In this chamber variously coated pieces of iron were struck by an iron bar in a combustible atmosphere. The combustible mixtures were chosen to be representative of the wide range of inflammable gases and vapors encountered in industrial processes. The fuels were as follows, the percentages being the proportion by volume in the air.

Carbon Disulphide ....(7 per cent)
Coal Gas .....(18 per cent)
Ethyl ether .....(3 per cent)

continued on page 112

Which Circuit Breaker for Industry — Oil or Oilless?

Industrial circuit breaker trend has been toward the oilless magnetic blow-out type and away from the older oil-filled kind. Here the two types of breaker are explained and compared. In a future issue maintenance procedures will be compared for both types of breaker

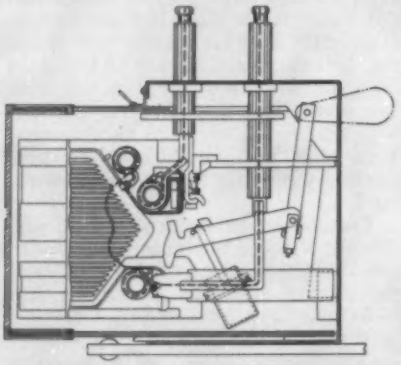
By W. B. WILSON* and JAMES ERWIN†

MOST IMPORTANT requirement leading to the development of the oilless circuit breaker was the need to eliminate oil with its known disadvantages and hazards. Until recently, however, the insulating materials available for use in certain parts of the oilless circuit breaker and its associated switchgear were not all that was desired from a flame retardant standpoint. But now materials have been developed which have excellent flame retardant characteristics in addition to all other required mechanical and insulating properties.

One such material developed by General Electric has self-quenching qualities obtained from an additive which quickly smothers any flame that may have been initiated by momentary or extended exposure to any form of fire. It will not sustain combustion. By the use of this insulation in the oilless breaker a highly desirable safety objective has been achieved.

Fig. 1. Oilless breaker showing control wiring and current tripping mechanism

Fig. 2. Dotted line in cross section below shows current path through breaker



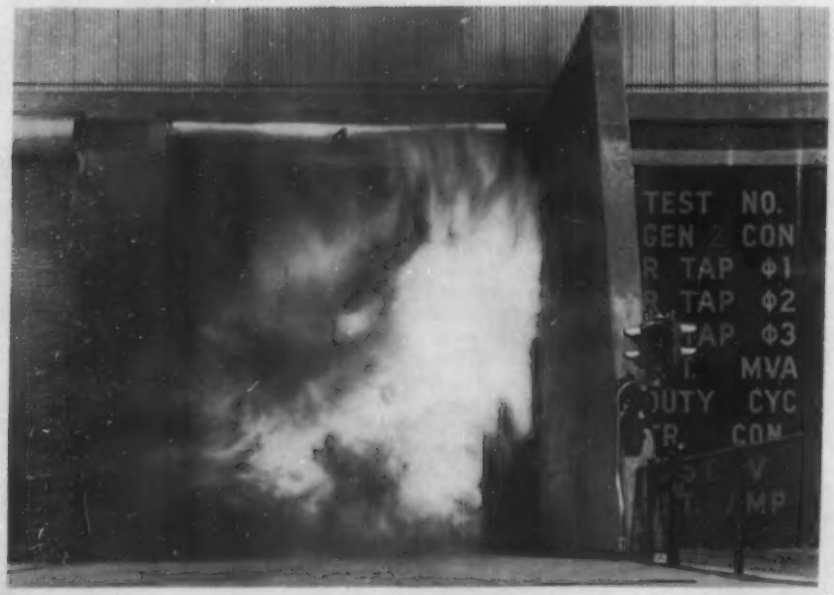


Fig. 3. Oil breaker exploding. Fire risk is one of disadvantages of oil breakers

There are wide differences in the design characteristics desired to meet the operating and installation requirements for power circuit breakers over the range of voltages from 2.8 to 330 kv. What may be most important in medium voltage circuit breakers for use in metal-clad switchgear does not necessarily apply to all power circuit breakers, particularly those of the higher voltage and of the outdoor type. The conclusions drawn in this paper apply to medium voltage power circuit breakers in metal-clad switchgear for voltages of 13.8 kv and below and interrupting ratings of 500 mva and below.

General Principles

The designs of medium voltage power circuit breakers for metal-clad switchgear manufactured and applied in this country are of two general types — the oilless circuit breaker, which utilizes the magnetic blowout principle of arc interruption, and the oil circuit breaker which operates on the oil blast principle. Either type may be used in metal-clad switchgear for both indoor and outdoor service.

The Oilless Circuit Breaker: The simplicity of this breaker, plus the fact that no oil or air tanks with compressors are required, has made it the general choice for both utility and industrial applications. A breaker of this type, complete with its operating mechanism and solenoid control relay, is shown in Fig. 1.

The absence of oil or air compressors makes the oilless breaker particularly desirable from a maintenance standpoint. In addition, the principle of arc interruption, described below for the magne-blast breaker, shows that the magnetic blowout method of interruption has

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distinct advantages over the oil or fluid blast design.

The magne-blast breaker interrupts the arc by magnetically forcing the arc into the gradually interleaving, closely spaced fins of the arc chute as shown in Fig. 2. These fins act to elongate the arc and restrict its cross-section, absorbing heat so that the electrical resistance in the path of the arc is greatly increased and the resistance voltage drop becomes an appreciable percentage of the circuit voltage. This increased resistance at high fault currents reduces the current and increases the power factor of the circuit, which minimizes voltage disturbance when the circuit is interrupted. The breaker is subjected to less burning and mechanical stress, giving longer life.

The Oil Circuit Breaker: Unlike the oilless breaker, the oil circuit breaker functions as a low arc resistance interrupter. Fig. 3.

This breaker interrupts the circuit by drawing a short, low resistance arc in a tank or chamber. This low resistance is abruptly replaced by a high resistance dielectric when a blast of oil is forced into the arc path, interrupting the circuit at a current zero. Immediately after this current zero, voltage across the contacts begins to rise to system voltage which is at its crest (zero P.F. fault). The actual recovery voltage across the contacts will rise above system voltage and quite often approaches twice normal circuit voltage.

Performance—Excess Currents

Even though none of us like to admit it, new generation and/or utility ties have sometimes been added to some of the older installations without carefully considering the increased short circuit duty imposed on all parts of the system. Even without additional ties, there are several instances where increased capacity on the utility system has increased the short circuit duty on breakers in the industrial system beyond the limits for which this equipment was designed.

Many circuit breakers now in service are being used in systems where the available short circuit duty is several times the interrupting rating for which the breakers were designed. Sometimes this fact is recognized but immediate corrective action is not taken. In many cases, however, no thought has been given to this serious matter at all. Periodic checks of the entire electric power system will insure that any changes which may have been made, or contemplated, will not produce short circuit currents in excess of the equipment rating.

All agree that oil may constitute a leakage and fire hazard. This is particularly serious when breakers are subjected to short circuit duties in excess of their rating. In our Switchgear Development Laboratory in Philadelphia, facilities are available for testing electrical equipment beyond rated capacity. Figure 3 shows the resulting explosion when an old design of oil breaker was tested at twice its interrupting rating. Figure 4 is a view showing some of the breaker parts remaining after test. It is well to remember that this breaker was subjected to only twice its rated fault current.

Fig. 4. Picking up bits and pieces of an oil circuit breaker after an explosion

Oil breakers have given satisfactory performance when properly maintained and applied within their rated capability. A review of published data does, however, reveal that production time is often lost due to the failure of oil circuit breakers and subsequent fire damage, when these breakers are misapplied. The actual photograph, Fig. 5, is an indication of the seriousness of the fire hazard.

It is not intended to imply that the oilless breaker will perform satisfactorily when subjected to currents in excess of its rating. Experience indicates, however, that consequential damage is far less in the case of the magnetic breaker failure primarily due to the absence of oil.

Application

General: Most industries feel that they have problems in the selection of electrical equipment which are peculiar to their industry alone. In many cases this is true. For instance Central Stations, Chemical Plants, Oil Refineries and other industrial plants (particularly the process industries) certainly have many conditions that pose special problems. These, however, usually resolve themselves without too much difficulty.

The selection of oilless vs. oil circuit breakers is the subject of discussion in some industries, probably because both types of interrupters are available and can be correctly applied. Even though the oilless circuit breaker was only placed in commercial production in the late '30's, it has received wide acceptance in industry, and its popularity has increased rapidly in the past ten years.

Table in next column, taken from G-E's circuit breaker sales, shows clearly the trend towards the use of the indoor magnetic type breaker in practically all industrial and utility plants. The table shows the numerical percentages for each type of breaker furnished by G-E in metal-clad switchgear:

Year	*Oilless*	*Oil*
1941	8%	92%
1949	92	8
1953	98	2

As is evident from the table, magnetic circuit breakers now have wide acceptance in the major industries.

In Corrosive Atmospheres: In areas where the corrosive gases are of such concentration as to adversely affect the maintenance or operation of any equipment, manufacturers have recommended that the electrical equipment be housed in rooms supplied with clean, dry air. A few early attempts were made to produce gas-proof switchgear equipment but this idea was abandoned because of the extremely high cost.

When it is impractical to locate switchgear away from these corrosive atmospheres, additional precautions must be exercised to minimize maintenance Even in these corrosive atmospheres, it is generally agreed that the over-all problems of maintenance are decreased when oilless breakers are used in equipment instead of oil breakers. Experience indicates that the oilless breaker can be applied for any application where the oil breaker might have been considered in the past.

The operating mechanisms, the auxiliary and protective relays and their contacts are comparable for both the oil and oilless breakers and are the parts most susceptible to corrosion in either breaker. The only significant difference in design detail is that the main breaker contacts are oil immersed in the oil circuit breaker instead of the contacts being in air for the magnetic breaker.

Experience has proved that heaters, which maintain the temperature of switchgear parts above the dew-point, are the greatest deterrent to corrosion, for in the absence of moisture, most industrial gases have little effect.

For contaminated atmospheres, space heaters keep the temperature within the oilless breaker enclosure

Fig. 5. These paper mill oil breakers did not have enough interrupting capacity to clear a fault on the system

. . . . *continued from page 81*

well above the dewpoint of any corrosive gases which might attack the contacts. This feature minimizes the effect of corrosive gases which might cause deterioration of any part of the breaker element including the main contacts.

Several papers have been presented in AIEE and elsewhere on the behavior of silver contacts. There is general agreement that the resistance of contaminated silver contacts, in air or in oil, will decrease during operation. A simple experiment that indicates how readily sulphide contamination disappears can be performed by heating a heavily sulphided silver strip with a match or by passing current through the strip. One can watch the black sulphide disappear rapidly and completely, leaving the original, bright silver surface.

The broad principle behind the above phenomenon is well known. Silver is one of the few metals found in the metallic state in nature, and it has the characteristic natural tendency of these noble metals to revert to the metallic state. For instance, silver does not form an oxide coating in free air.

Sulphur and chlorine are examples of the common contaminants found in industrial plants. Even if these elements should attack the main silver contact surfaces of any breaker while in the open position, breaker performance will not be impaired. Sulphur compounds are chemically unstable in the presence of heat and will decompose at a temperature well below any temperature that would damage the breaker contacts. Chlorine compounds are unstable both mechanically and chemically. Under contact pressure and heat, the chlorides will flow away from the contact area and the current carrying capacity of the contacts will not be appreciably reduced.

It must be recognized that contact contamination is much more likely to occur when breakers are out of service for extended periods of time. A visual inspection of the contacts and mechanisms is recommended before energizing these units and this applies to oil and oilless breakers alike.

In Explosive Atmospheres: Neither the oil nor the magnetic breaker is suitable for installation in explosive atmospheres. Both types of breakers utilize "air-break" limit switches, relays and auxiliary control devices, in which arcing does occur. Even this small amount of arcing is sufficient to prevent the application of these circuit breakers in explosive atmospheres.

Some few attempts have been made to locate all contacts under oil or in explosion-proof enclosures but this has not been found economical. Medium voltage switchgear is normally located outside "battery limits" or else in air conditioned or pressurized switchgear rooms supplied with clean fresh air.

For Repetitive Duty: For applications such as arc furnaces in the steel industry and others requiring frequent breaker operation, the ability of the magnetic breaker to do the job with minimum maintenance makes it the choice of practically all users.

According to present industry standards for 1200 ampere breakers, oil should be renewed each 500 non-fault operations. The magnetic breaker should not require replacement of parts until after 5000 non-fault operations. Experience has proved that these values are very conservative for the oilless breaker.

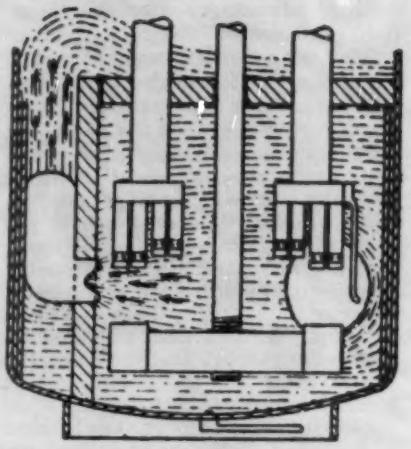

Fig. 6. Section through oil breaker tank

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Gas-Insulated Transformers Are On the Drawing Boards

HIGH-DIELECTRIC gaseous insulation will be tried on two new 69-kv, 2000-kva transformers, a joint development project of G-E and Consolidated Edison (N. Y.). If the field tests go well, future transformers may be lighter, quieter and safer than present liquid insulated and cooled units.

While gas insulation is not entirely new, this is the first application as high as 69 kv; the previous maximum was 15 kv. The gas being used is sulfur hexafluoride under pressure, which has a higher permissible rating than Pyranol (46 kv) while affording similar protection against fire.

W. S. Ginn, general manager of the G-E Power Transformer Dept., said it foretells the eventual displacement of oil- and askarel-filled transformer construction by gas-filled, dry-type construction. He also suggested that the practical application of gas as a high-voltage transformer insulation and coolant is probably the most radical change in transformer design concepts since the introduction of non-aging silcon core steel in 1903.

Compressed gas is a much poorer transmitter of sound than liquid, hence the new units are expected to be much quieter in operation. Gas insulation should also do away with the chore of oil filtering. Laboratory tests of the physical properties of sulfur hexafluoride under moderate pressure indicate also that it is as promising as a coolant as it is in its dielectric role. Field tests conducted by Consolidated Edison may well prove the dielectric properties even better than indicated by the tests.

This is a development we will watch with considerable interest.

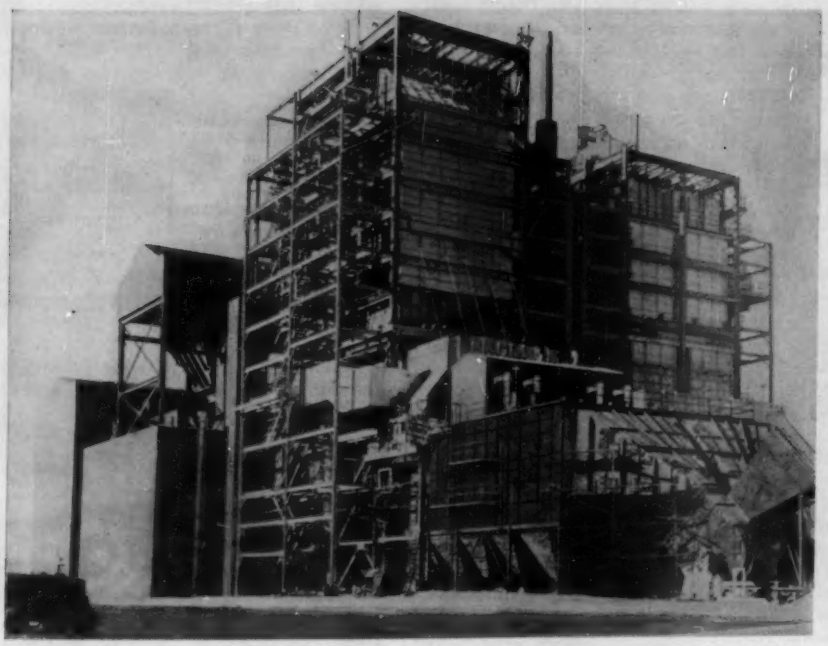


Fig. 1. A good example of clean functional design in two modern outdoor steam generators at the Gadsby Plant of the Utah Power & Light Co. in Salt Lake City; reheat unit in foreground

Modern Insulated Boiler Settings Must Stand the Gaff

Here, in the second of two articles on modern boiler settings, the author discusses outdoor installations and insulation application

By L. D. BRUCE*

OUTDOOR INSTALLATIONS of steam generating units are becoming more and more popular, especially in the southern part of the country. A steam generating unit, completely steel encased, does not require a building to protect it from the elements. The steel casing provides protection as substantial as any building which could be placed over the unit. From an architectural standpoint, the appearance of a well-constructed steel encased setting, nicely painted, can be as attractive as any boiler house building, no matter what its design may be.

The argument occasionally advanced that maintenance personnel are exposed to the elements while doing repair work may have been of some significance in the past. Present day designs of steam generating units and greater knowledge of boiler water chemistry insure almost unlimited reliability of many modern installations. Shutdowns for inspection and maintenance on such installations can be scheduled for seasons in which the weather is agreeable.

To summarize, a completely air-tight steel encased setting presents attractive, economical advantages over the more commonly known refractory or semi-steel encased settings. In the design of new installations it may be well to consider this method of setting boiler enclosures.

Absence of air leaks into the setting results in power saving for the induced draft fan, in maintenance of high efficiency, and elimination of the possibility of reduced steaming capacity of the unit caused by overloaded induced draft fan.

The strong steel jacket covering the entire unit provides protection against damage from internal dust and gas explosion.

Maintenance expense of a correctly constructed steel casing is practically nil and consists only of painting.

Lower total weight of this type of setting reduces cost of foundation work and structural steel.

Under favorable conditions, an entirely air-tight and weatherproof steel shell covering a steam generating unit eliminates the necessity for a boiler house.

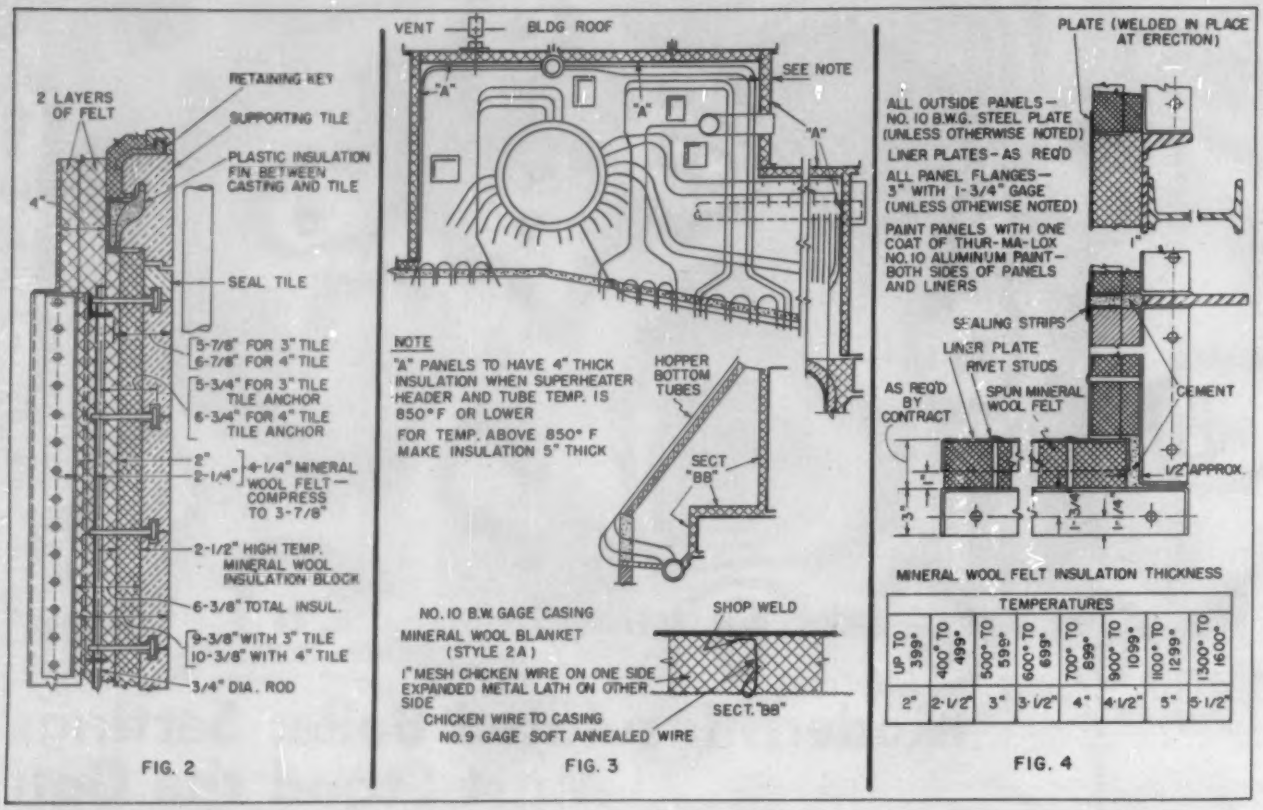
Details of Setting

Proper alignment of water wall tubes in the field is extremely important to optimum operation of a boiler. The furnace envelope (the walls surrounding the combustion chamber of a boiler) is formed by water wall tubes, usually on 3⅜-in. centers. Because the tubes are 3¼ in. OD, there is only ⅛-in. space between the tubes. This space must be retained uniformly across the entire width of a wall panel. It is best accomplished by using soft No. 11 gage baling wire tied around each tube. Space occupied by the No. 11 gage wire will retain the ⅛-in. clearance between the tubes.

The tubes must, of course, be in true alignment from one side to the other of a wall panel. A permanent setting structure is impossible if one tube projects into the furnace, or out of it, by as much as ¼ in. If a tube is out of line, the space between this tube and the tubes next to it exceeds a theoretical ⅛ in. and although this wider space will eventually be closed with refractory, the refractory may be attacked by abrasive ash and may be cut out during operation. Tube anchors may be used to pull or push the tube into line, or, it is possible to attain true alignment by tying wood or steel flats across the tubes, using No. 11 gage tie wires and twisting the wire. To keep the tubes in alignment, tube spacers can be welded over the outside of the tubes or small angles may be welded to the outside of the tubes.

Long water wall tubes, especially those intricately bent, are flexible and may be slightly deformed in shipment. It is then often necessary to force the tubes in alignment after their ends are inserted in drums and headers and, under extreme conditions, heating of the deformed tube with an oxyacetylene torch may be necessary to assist forcing the tubes in line. It is especially important for the tubes to be in true alignment around opening for doors, soot blow-

*Chief Project Engineer, Riley Stoker Corp.


2 LAYERS OF FELT
RETAINING KEY
SUPPORTING TILE
PLASTIC INSULATION FIN BETWEEN CASTING AND TILE
4"
SEAL TILE
5-7/8" FOR 3" TILE
6-7/8" FOR 4" TILE
5-3/4" FOR 3" TILE TILE ANCHOR
6-3/4" FOR 4" TILE TILE ANCHOR
2"
2-1/4"
4-1/4" MINERAL WOOL FELT — COMPRESS TO 3-7/8"
2-1/2" HIGH TEMP. MINERAL WOOL INSULATION BLOCK
6-3/8" TOTAL INSUL.
9-3/8" WITH 3" TILE
10-3/8" WITH 4" TILE
3/4" DIA. ROD
FIG. 2
VENT
BLDG ROOF
SEE NOTE
"A"
NOTE
"A" PANELS TO HAVE 4" THICK INSULATION WHEN SUPERHEATER HEADER AND TUBE TEMP. IS 850°F OR LOWER
FOR TEMP. ABOVE 850° F MAKE INSULATION 5" THICK
HOPPER BOTTOM TUBES
SECT "BB"
NO. 10 B.W. GAGE CASING
MINERAL WOOL BLANKET (STYLE 2A)
1" MESH CHICKEN WIRE ON ONE SIDE EXPANDED METAL LATH ON OTHER SIDE
CHICKEN WIRE TO CASING NO. 9 GAGE SOFT ANNEALED WIRE
SHOP WELD
SECT. "BB"
FIG. 3
PLATE (WELDED IN PLACE AT ERECTION)
ALL OUTSIDE PANELS — NO. 10 B.W.G. STEEL PLATE (UNLESS OTHERWISE NOTED)
LINER PLATES — AS REQ'D
ALL PANEL FLANGES — 3" WITH 1-3/4" GAGE (UNLESS OTHEWISE NOTED)
PAINT PANELS WITH ONE COAT OF THUR-MA-LOX NO. 10 ALUMINUM PAINT — BOTH SIDES OF PANELS AND LINERS
SEALING STRIPS
LINER PLATE RIVET STUDS
AS REQ'D BY CONTRACT
SPUN MINERAL WOOL FELT
CEMENT
1/2" APPROX.
MINERAL WOOL FELT INSULATION THICKNESS
TEMPERATURES
UP TO 399°
400° TO 499°
500° TO 599°
600° TO 699°
700° TO 899°
900° TO 1099°
1100° TO 1299°
1300° TO 1600°
2"
2-1/2"
3"
3-1/2"
4"
4-1/2"
5"
5-1/2"
FIG. 4

Some details of boiler setting insulation practice are shown here: A sectionally supported sidewall (Fig. 2); typical application, internal insulation on casing panels (Fig. 3); welded construction, double panel insulated casing (Fig. 4).

. . . . Boiler Settings Must Stand the Gaff *continued*

ers and burners. The tubes are usually bent in or out of the furnace wall line and they are used to support refractory around door openings. These tubes must perform as a unit when expanding or contracting with temperature changes so that the refractory surrounding openings will not crumble. Welded-on tube spacers and ties must be used liberally above and below all the openings after the tubes have been brought into alignment.

Wall Tube Alignment

Correct alignment of the wall tubes is of such extreme importance for successful application of the setting and to insure a permanently tight setting, that it is recommended that the completed tube system be carefully inspected, including the anchoring of the tubes, their alignment, and the provisions made to keep the tubes in alignment, before any part of the setting structure is started. Unless the tubes remain in shape and are prevented from moving out of alignment when heat is applied to the boiler, it is almost certain that the setting will fail.

The entire area of the furnace side walls, rear wall, and a portion of the furnace front wall, where water wall tubes are on 3⅜-in. centers, is covered on the outside with a lightweight plastic refractory. To support this refractory and reinforce it, expanded metal lath is used, tack-welded to the outside of the tubes. This metal lath is placed over the outside of the tubes and flush with them, then tack-welded to the water wall tubes on approximately 18-in. centers, both horizontally and vertically. Care must be taken that the refractory is well worked through and over the expanded metal and that it is firm and free of joints. The outside surface of the finished applied refractory need not be perfectly smooth, but must be flat without high or low spots.

Tubes, expanded metal lath, and applied refractory expand to the same degree when heat is applied. The refractory therefore moves with the tubes, whereas insulation and casing are supported on external structural steel and do not expand and contract. The face of the refractory therefore slides on the face of the insulating block as expansion takes place.

Application of Insulation

After the plastic refractory is set and reasonably firm, the installation of insulation and casing is made. Starting with the lowest horizontal casing supporting buckstays, mineral-wool insulating block is applied over the area covered by one casing panel. There should be no noticeable joint between insulating blocks. They must be set firmly against and on top of each other, and open crevices, such as at block joints and openings, should be filled with insulating cement. There should be no crevice between the insulating block and face of the applied plastic refractory. The block insulation is 2-in. thick (for 3¼-in. tubes on 3⅜-in. centers) and, if set firmly in place and against the applied plastic refractory, the block will support itself over an area equal to that of a casing panel.

Next step is application of 2-in.-thick mineral-wool felt sections. It is very important that the entire area over which the casing panel is to be placed is covered by the mineral-wool felts without interruption and without crevices or holes.

Where the height of the area to be covered is such that insulation block or felt will not stay in place before the casing panel is set, it may be necessary to wire the insulation to tubes or tile. For this purpose, No. 9 gage wires may be tack-welded to tubes prior to application of refractory and insulation.

To provide a firm support and prevent settling, 2-in.-thick felt sections are compressed to 1⅝-in. thickness upon the installation of the casing panel.

After an area equal to one casing panel is thus insulated, the casing panel will be installed by supporting

the lower flange of the panel on the structural steel member and holding it in place with drift pins inserted through bolt holes in the lower flange of the panel and the corresponding holes in the structural steel member. This method provides a hinge for the panel to be sprung in place and so allows the necessary pressure to be applied to compress the mineral wool felts.

It is not practical to install insulation and casing over an area greater than one panel at a time. Block, felt, and casing panel must be installed in sequence for each unit or area of wall to be covered by one panel.

Fill All Voids

It is of great importance that the space between casing panel and water wall tubes be completely filled with no void, opening, or joint. Improperly applied insulation between the casing and plastic refractory may settle with the vibration to which the boiler setting is subjected while in service. If there are openings through which high temperature combustion gas will pass, the casing will overheat or the voids may fill with coal dust so that a fire may start behind the casing which will destroy part of the setting. Therefore, extreme caution is required in applying insulation and casing to ensure that there can be no settling and that no open space will remain behind the casing.

The casing can be bolted or welded but installation of the individual casing panel remains the same for either method. If the casing is constructed for bolted joints, flanges of the casing panels should be coated with a sealing cement. The cement should be troweled over the entire width and length of the casing flanges uniformly with a fairly thick coat. This will seal casing joints against air and gas leakage.

All-Welded Joints

If the casing is constructed for all-welded joints, no sealing cement should be used between casing flanges, but the casing panels can be bolted to the supporting structural steel and to each other with widely spaced tack bolts.

When the air heater forms the rear wall of the boiler, all joints of the steel division wall should be completely welded. This is necessary to prevent air leakage from the air side of the air heater into the gas path of the boiler. Usually, the supporting structural steel members of the boiler settings are so located that they must be insulated before other equipment is installed. Access to these members may not be possible after casing and ductwork are in place. Therefore, it is necessary to apply insulation, where required, before these members become inaccessible.

Where clearance must be provided between water wall tubes and setting to allow for the expansion of the parts, a sectionally-supported wall can be used (Fig. 2). This may be along the upper part of the furnace front wall or also over certain areas of the side walls and rear walls of the boiler setting where the tube spacing is so large that tubes will not provide support for tile, or where the longitudinal expansion of drum and headers requires clearance between tubes and setting. This type of wall is entirely suspended from external structural steel and is not in contact with pressure parts, tubes, headers, or drums. It is important, however, that the space between supported tile and casing is filled completely with insulating block and felt insulation, with the felt compressed tightly behind and between the metal part of the tile supports, so that there is no crevice and no possibility for gas and dust to leak into the space between tile and casing. Edges of the tile are dipped into or buttered with high temperature cement before the tile is set in place. This is to seal off the joints between tile and insure the heads of the tile supporting anchors to be imbedded in the tile without crevice and without clearance.

Furnace Hopper Bottoms

Front and rear slopes of furnace hopper bottoms are usually formed by continuation of front and rear wall tubes spaced on 3⅜-in. centers, bent so that the inclination of the slopes is more than 45 deg above horizontal. In assembling the covering of the hopper bottom slopes, extreme care must be taken to prevent the possibility of leakage of fly ash and dust from the furnace into the space below the slopes. The finished covering should be inspected and every joint and crevice should be pointed up. This work must be done before the insulated casing housing, spaced below the furnace floor slopes, is installed.

The design of many boiler units with water-cooled furnace hopper bottoms shows the space below the slopes of the furnace floor totally enclosed by paneled steel casing, which is the continuation of the furnace rear wall casing and furnace front wall casing. This space contains the feeder tubes and is subjected to the temperature of the water in the tubes, which may be as high as 600 F with the boiler in service.

Enclosure of this space consists of steel panels covered on the inside with 3-in.-thick mineral wool insulating block. The inside face of the panels is studded with welded-on wires which are attached in the shop. Application of the 3-in.-thick insulating block is done during erection.

Much of the inside area of this enclosure is accessible for application of insulating block after steel panels are in place, but part of the area is obstructed by feeder tubes so that the block could only be installed with great difficulty after the panels are in place. Therefore, certain casing panels which will directly cover closely spaced feeder tubes should be selected for the application of the insulating block before the panels are set in place.

In applying the insulating block, great care should be taken that the block be held tightly against the face of the casing panel, because dust will settle into the crevices between block and casing. This can lead to eventual failure of the insulation and would cause hot spots on the outside of the casing. The finished installation of the lower enclosure should be inspected from the inside to verify that every part of the casing area is covered with insulation at least 3-in. thick. All tubes, headers, and other pressure parts within this enclosure should remain bare of insulation.

Penthouse Closure above Boiler

Superheater headers, steam releaser tubes, and other pressure parts located above the furnace are usually housed by a penthouse type enclosure consisting of steel panels, internally insulated (Figs. 3 and 4). The thickness of insulation is greater because the operating temperature within the penthouse is usually 900 to 1000 F.

The penthouse closure steel housing should be installed after all pressure parts are in place and all pressure welds are made.

Where there are large areas of roof with insulation thickness of 4 or 5 in., it is necessary to use a sandwich construction to prevent sagging of the insulation. In this design, the insulation is contained between two panels held together by riveted studs which are spaced on approximately 2-ft centers.

Carefully inspect the finished insulation to verify that every part of the casing is completely covered, that all joints between blocks are sealed by insulating cement.

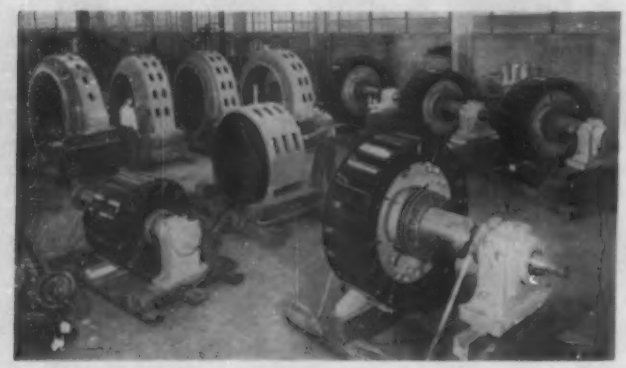
It is clear from this analysis of boiler setting design that the proper insulation correctly applied is essential to the operation of the modern boiler setting.

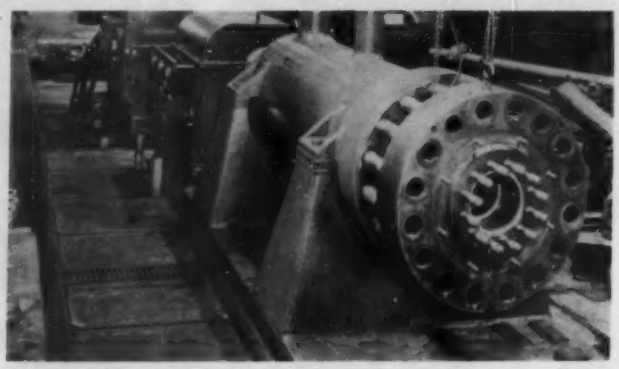
Demineralizer System Design Factors—Correction

IN ARTICLE with above title, pages 90–91, October 1954 issue, readers have doubtless noticed that the captions of Figures 3 and 4, top of page 91, were transposed. The upper drawing with the caption, "Three-bed system" shows the four-bed system, while the lower drawing showing a three-bed system is captioned "Four-bed system." Please mark your copies to show this transposition. It occurred during a last minute change in make-up, and we are mighty sorry if it has confused anybody.

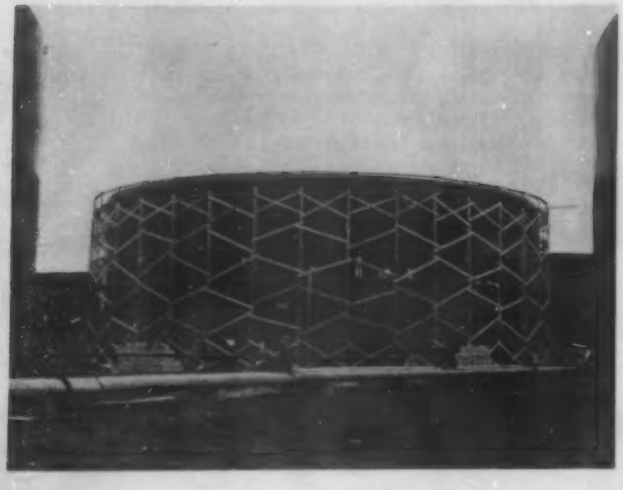
News Reel

HIGHGROVE STEAM PLANT of California E. P. Co., outdoor construction, requires only 4 men per shift to operate its two 30,000-kw units, or 7 men for its full 120,000-kw capacity. Write to the editor for a descriptive booklet



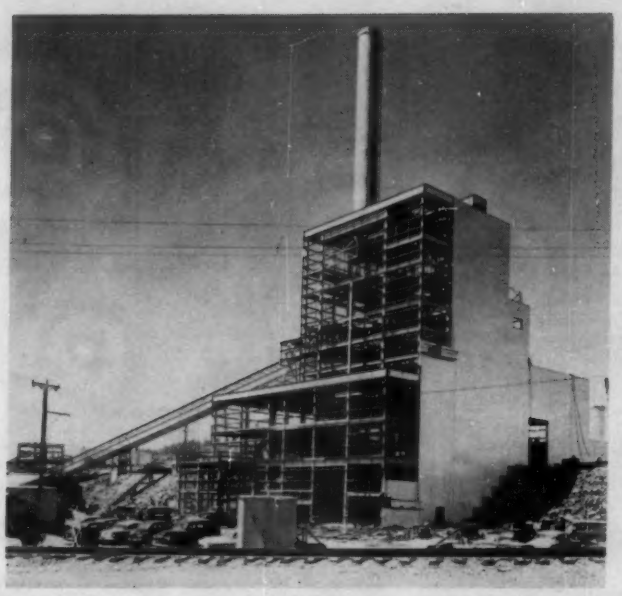


HIGH PRESSURE calls for tough pumps like the one (above) forged by Heppenstall for United Centrifugal Pumps. The barrels are 4-in. thick; with rating of 1300 gpm, 3400 psi

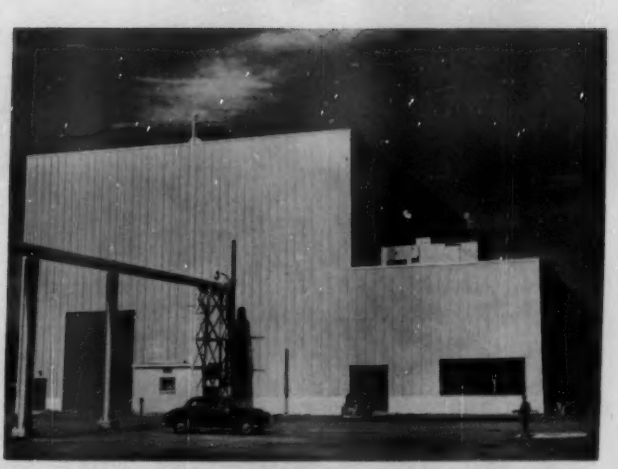


WHEN EXPLOSION and fire knocked out the electric generating equipment (above left) of the Columbus, Wisc., power plant, the entire equippage was hauled into the Westinghouse Milwaukee shops for overhaul. A connection was established between Columbus and the Wisconsin Power and Light Co. within 36 hours, restoring service

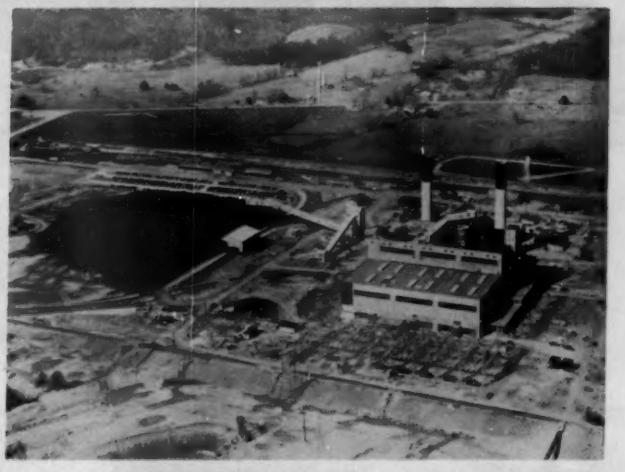
CELLULAR GLASS (left) was employed to reduce heat losses from four huge oil tanks at River Rouge when waste steam was curtailed. Tanks stay at temp of 120 F



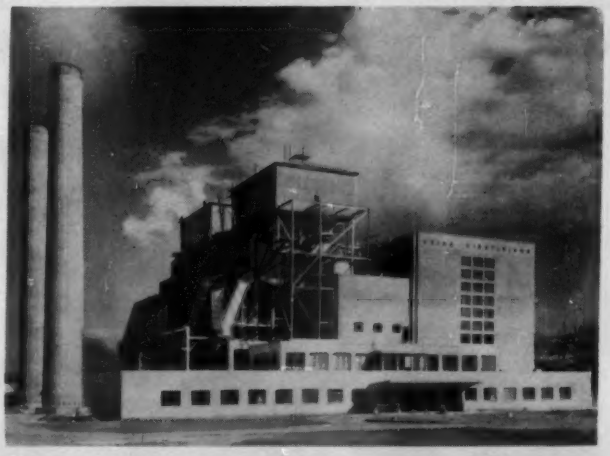
POWER for taconite project (above) at Silver Bay, Minn., will be provided by a 40,000-kw steam plant. New methods of taconite processing promise a new lease of life for the dwindling ore reserves of the huge Mesabi iron ore region



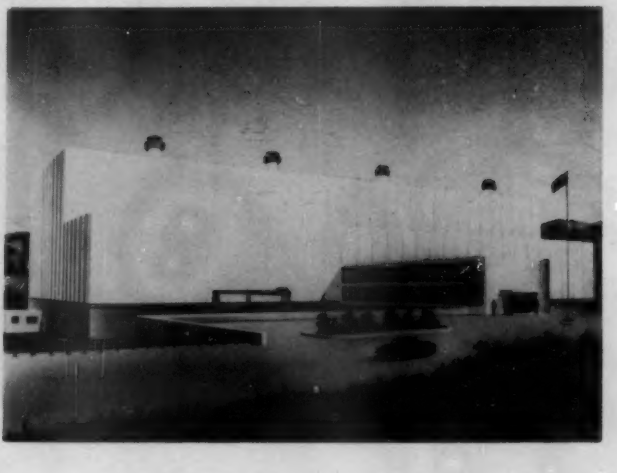
GE'S NEW $3,500,000 steam turbine test lab (top right) is set up for component development as well as for high and low pressure turbine section test and development



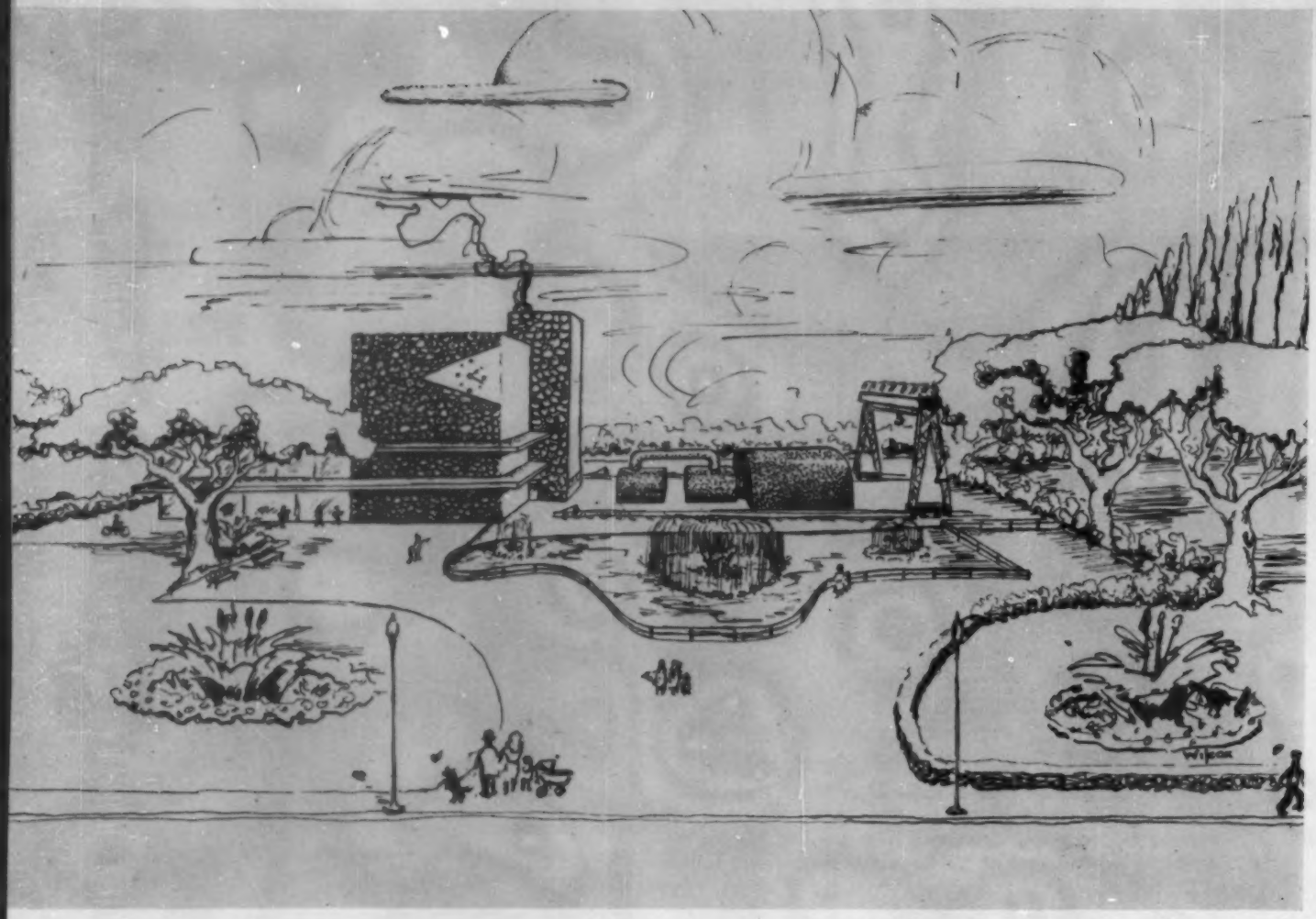
PLANT HAMMOND, Rome, Ga. (aerial view, right), started the second of its three 100,000-kw generating units in September 1954. Last one will start in the summer of 1955



BRAZIL'S largest steam-electric plant (second from bottom right) was designed and built by the Stone and Webster Corporation for the Sao Paulo Light and Power Company



ARTIST'S SKETCH of new Encina Station (right) of the San Diego Gas & Electric Co. The first of four proposed generating units, costing about $18-million, is now on line



What Industrial Design Can Do for the Power Field

By ROBERT H. EMERICK*

WILL THE INCREASING application of industrial design to our power plants mean that, eventually, we shall have pink panties on our smokestacks and ruffles on our water columns? Can we expect the plant as a whole to put aside its familiar shape and come to resemble, perhaps, a gigantic, stackless dewdrop glistening in a mid-city garden?

To evaluate these fanciful possibilities suppose we consider what industrial design has already done to our power plants. An out-door transformer station is pictured in Fig. 1. This recent design has achieved these highly desirable features: (1) A streamlined, neat appearance makes its presence far more acceptable in residential neighborhoods — which was certainly not

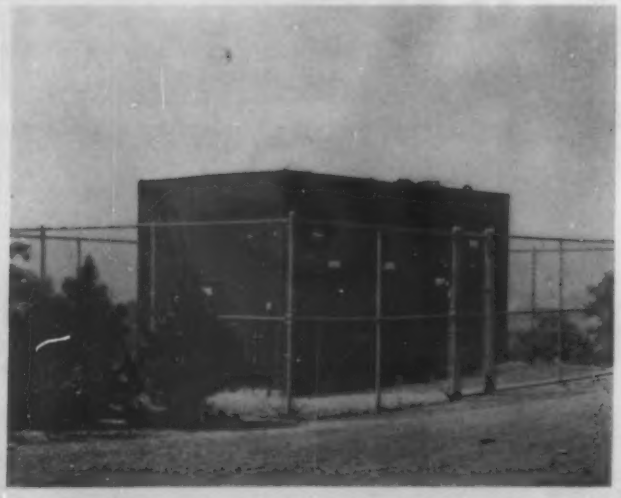
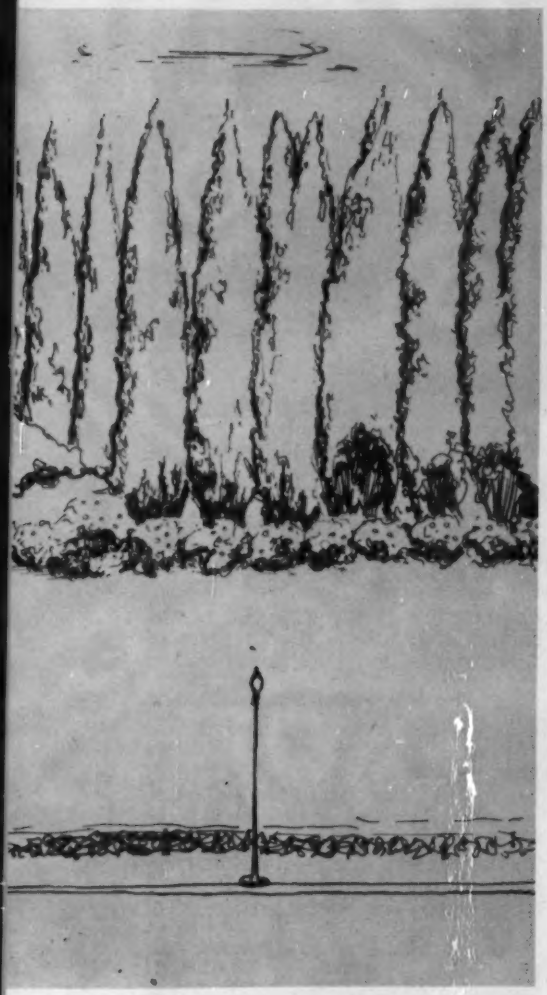


Fig. 1. Example of functional design in a new transformer for use in residential area where appearance is important

*Captain, USNR; Chief, Industrial Division, Panama Canal Co.



true of its ancestors; (2) the station is safe electrically against accidental or mischievous contact; (3) the design saves installation money, because additional safety permits the omission of the fence, if that be desired; (4) an air-insulated, load-break switch has been coordinated into the transformer compartment; by thus using to best advantage the possible physical arrangement, the overall appearance and operating characteristics of the unit have been improved.

This photograph demonstrates clearly the objectives of industrial design as applied to power plant equipment — to enhance appearance and, at the same time, improve ease of control, safety, and dependability of a machine. These objectives are attained by "streamlining," provision of dirt and dust protection, and arrangement of its internal components to the best possible advantage. How well these objectives have been achieved in one case can be noted in Figure 1.

At this point we might observe a curious result of the original purpose of industrial design, which primarily was to make items more saleable in the market by giving them an improved shape and style appeal. Early attempts to use this approach in redesigning machinery were failures, as designers knew much about shape and style but little about function, and more than one manufacturer has their still-born creations buried in his dead files. However, these experiments in shape and style have pointed the way to better arrangements of equipment internals *from the engineering viewpoint;* for example, the coordination of the switch in the transformer shown in Fig. 1. Simply by attempting to improve the outward appearance of a machine, we ofttimes stumble on highly desirable engineering improvements in the process.

Inside the Plant

Figure 2 shows what has been done inside the power plant to reduce dust and dirt spillage from stoker-fired boilers. This design is good as far as it goes, but a few more dollars of investment might have provided a transparent enclosure around the whole front of the stoker, perhaps a fabrication of glass, or lightweight plastic sheets. The improvement in both appearance and cleanliness of the firing aisle by the use of such an enclosure is easily visualized. In addition, the operator, if there is an operator, can still observe the positions of the rams at a glance.

Obviously, there is still much to be done in our boiler rooms by the industrial designers.

As a third example of progress, we have the motor design shown in Fig. 3. This large motor is strikingly different from the conventional motor in appearance, and its straight lines and smooth surfaces eliminate most of the dust and oil pockets common to its predecessors. Nonetheless, this unit has not yet reached the ultimate either in streamlining, dust-proofing, or, possibly, in use of materials. In later models, we probably shall find the end bell and conduit lead-in box completely enclosed inside the jacket, and the ventilating louvers arranged to provide better protection against floating and falling particles.

With the exception of Fig. 1, all of the examples given are indicative of a cautious approach to the possibilities of change, and even Fig. 1 is conservative to the extent of showing a fence around the transformer, although this fence is not essential. Jacketing and streamlining of turbine-generator combinations have been advanced by the out-door trend, but the problem of the designer is being expanded to include within his streamlining scope the turbine condenser, and possibly, the generator cooling system. In fact, a reversal of viewpoint already has produced a very large condenser designed to support the turbine, rather than vice versa.

Complete Integration

Once this viewpoint is established, it is a very short step to the production of a completely integrated kilowatt generator. The turbine, generator, condenser, pumps, etc., would be fitted snugly together within a streamlined box, and the purchaser need only connect his steam, water

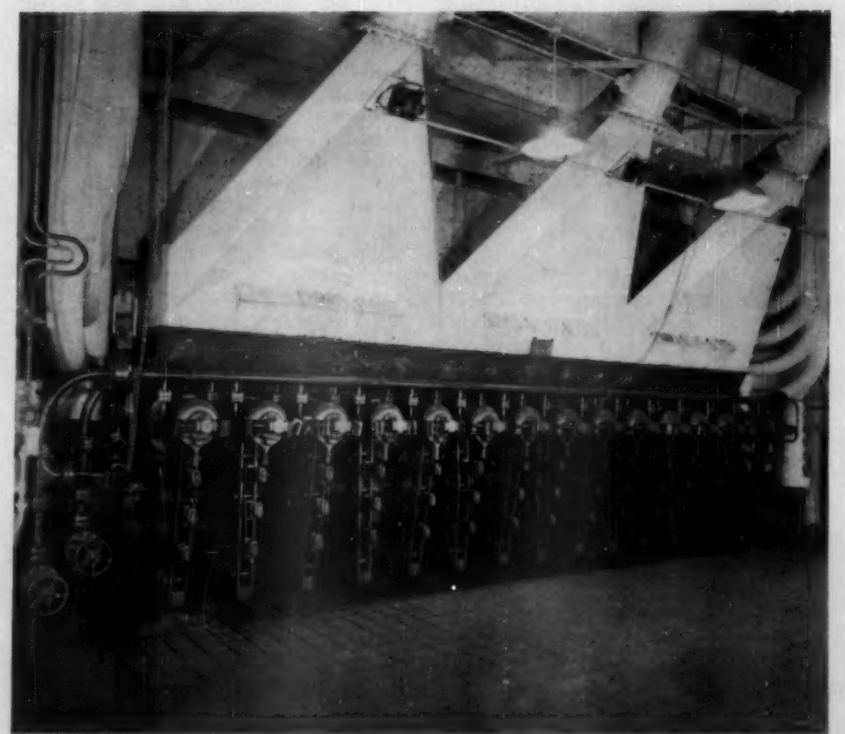


Fig. 2. Results like this can be achieved by application of good industrial design

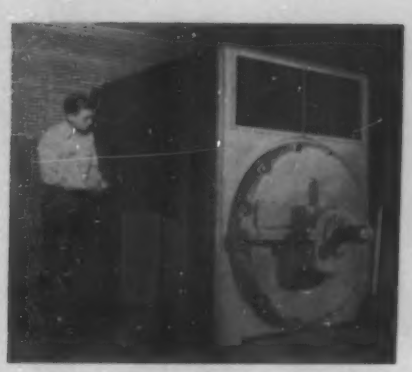


Fig. 3. Unusually clean design of large induction motor offers many advantages in both appearance and maintenance

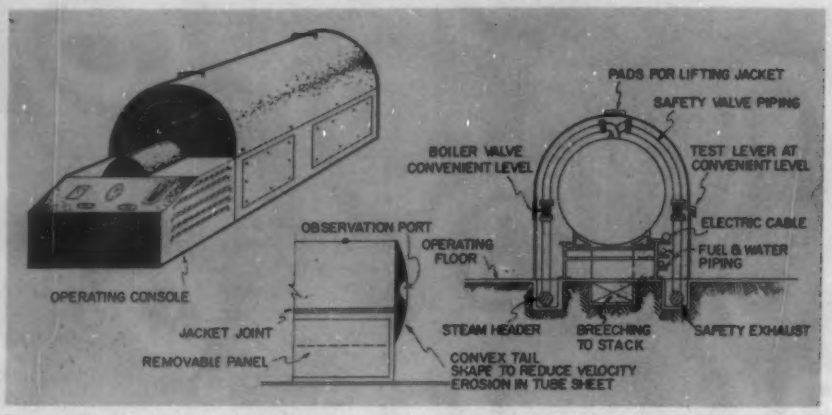


Fig. 4. Suggested design for packaged boiler of the future features simplicity

and electric leads to be ready for business.

Such simplicity of installation already is available in package steam generators. Figure 4 shows one of these fire-tube, package generators in which jacketing, streamlining, and arrangements for automatic operation have all been carried to an apparently logical conclusion. This unit, as illustrated, is not being offered currently by any of the established manufacturers, but its appearance may be just around the corner. This writer knows of discussions with some of the country's top industrial designers, and some preliminary drawings have been made for the consideration of one manufacturer's engineers.

Notable advantages to the purchaser of a boiler similar to that illustrated in Fig. 4, seem to be these: (1) Emphasis is placed on automatic operation, with no need for the operator to go "under the hood" except in times of repair and overhaul; (2) the elimination of projections and protuberances is an ally of safety; (3) cleanliness and neatness in the boiler room are increased; (4) the console type of instrument board brings together all unit instruments in a single, convenient, and easily visible location.

As remarked earlier in this discussion, the attempt to improve appearance by varying internal arrangements has resulted, in this case, in a suggestion to use a convex rear head instead of the conventional flat design. The convex head provides greater cross sectional area for gas flow in those sections of the boiler where the gas flow is reversed quite sharply, and thereby relieves somewhat the erosion on tube ends and sheet ligaments. This is important, because boilers have exploded from material failures in these areas.

Materials

While industrial design began primarily as creation in shape and style, present precepts of necessity must include the question of materials as well. For example, plastics, glass, aluminum, stainless steel, and other lesser-known metals are becoming noteworthy materials in power plant components.

Glass and plastics are performing successfully in the form of piping. The U. S. Navy has been using polyester piping reinforced with glass for more than three years in a warship, and recently has adopted a similar installation for a new vessel. This same type of material has been employed for fresh water tanks and oil tanks. As a result of satisfactory tests, these tanks also have been assigned to sea duty.

New Materials on Trial

All of these installations are on an evaluation basis, which means their performance over a period of years will be weighed against conventionally designed units. If service, first cost, dependability and ease of repair add up to the favorable figure now expected, these materials will be used widely at sea in the future. One advantage is that glass and plastics are more resistant to distilled water than are metals commonly employed for the handling of this fluid.

Figure 5 shows a boiler room wall in which use has been made of translucent, plastic panels. Since these walls permit the entry of diffused daylight over the entire expanse where such plastics are installed, we may expect to find more and more of them in our new plants.

We are all familiar with aluminum sheets in power plant curtain walls, and the next application of this metal will be in the plant structural, and semi-structural, elements. Aluminum is excellent for ladders, walkways, partitions — almost anywhere within its strength limits, and where the ambient temperature does not approach its melting level. Perhaps the main potential weakness of aluminum is in its low heat resistance; in the event of a plant fire, any temperatures much over 1000 F might bring on structural collapse.

The industrial designer is not expected to be a chemist to produce plastics, or a metallurgist to create alloys, or even a glass blower, but he *is* expected to evaluate these materials as they affect, or may be used in, his designs. How well he discharges this function is one of the factors that affects the progress of industrial design in our power plants.

Power Plant Shapes

If we pass from machinery details to the housing situation, we note that here both design and materials are in flux. The trail of the designers, usually architects in this case, leads from the great palaces of the 1920's to the outdoor and semi-outdoor designs of the 1930's, thence into the open air and functional structures of the present.

The problem, of course, is to provide cheap housing of acceptable appearance, built of materials that will last. This, at least, is the popular view of the problem. Actually, one phase of housing that is not currently active, but which has the potential to change our entire concept of plant shape and materials, is the possibility of so re-arranging the relative positions of the machinery that our familiar cubes and prisms will be replaced by rhomboids, spheroids, pyramids, dew-drops, and what not.

This may be done simply by fitting together the components under a common skin, just as was done in the transformer shown in Fig. 1, but on a much larger scale.

Designer's Responsibility

Since architects rarely have the time for such fantastic thinking, the industrial designer, whose business it is to dream up new shapes, becomes a factor in the housing future of our power plants. His responsibility will be to suggest forms and materials, and to support his suggestions with sound reasoning. The reasons may be no more complex than a desire to harmonize a plant with its surroundings, or to produce a structure so out of the ordinary that it has advertising value to its owner. The responsibility of the engineer is then to discover what improvements, if any, will re-

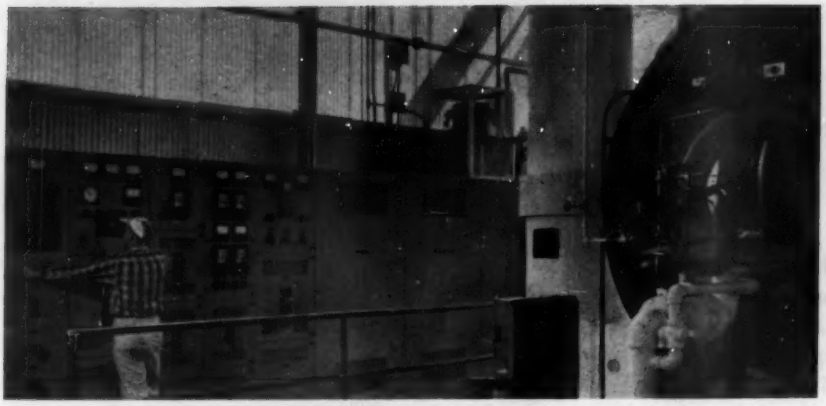


Fig. 5. Good appearance and improved lighting are obtained with structural glass

sult from the suggested form, when measured against conventional efficiency, safety, convenience, and automatic operation.

To illustrate, Fig. 6 shows how equipment might be packed into a "dew drop." Suspending the boilers from the structure might aid compactness, and certainly is not impractical. Automobile manufacturers have for years used the body framing as part of the chassis in some cars. Whether such suspension designs in a power plant will actually provide investment savings, or any advantage at all, is a matter for study.

Since this is a futuristic plant, the cascading of the circulating water over the building is in harmony with the idea of compactness, and might produce a saving in comparison with cooling towers, spray-ponds, or even river basin systems. In any event, no industrial designer would overlook the publicity effects of night lighting on such a cascade.

The idea of utilizing solar heat is certainly not new, but this application to a power plant feedwater system may be. In some areas of the country, notably Florida, California, and the Southwest, where hours of sunlight are both many and long, a fairly substantial fuel saving might be possible.

Centralized Controls

All control in this dew drop is concentrated on the operating platform and, if fully automatic possibilities are realized, one man per shift should be enough.

The leading illustration of this article suggests how an outdoor plant could be harmonized with a city location. As in the case of Fig. 6, this arrangement could become a show place, particularly if the surrounding area was suitably landscaped.

Both of these illustrations of plant shapes and arrangements show that dew drops and park-like power plants are quite possible, and actually might take form not too far in the future. The designers are producing automatic, untended power plants, sometimes controlled from considerable distances, and this trend is favorable to change. This sort of automation requires simplicity, dependability, a plant that stays clean, and one that is safe to leave untended. Certainly, an unwatched plant must be designed to prevent tampering, in all of its parts, and this is a part of the field of interest for the industrial designer.

The Industrial Designers

A comparatively young profession, born of the need to achieve mass sales for mass-produced products, its total number of practitioners is less than 10,000. Most of these are in the mass production centers of Detroit, Chicago, Milwaukee, New York, and many are on the payrolls of various manufacturers. Those competent to work in the field of power plant design probably represent less than one per cent of the total, but out of this tiny group will come a very considerable influence on our steam and kilowatt makers of the future.

The Society of Industrial Designers, which represents the profession, was organized in 1944 and presently counts 161 members. Membership qualifications are stringent, and the annual cost is substantial. Dues range from $24 a year for associates, through $50 for teachers and employees, to $540 for the head of a design office.

Georgia Tech Offers Course

Currently, 24 colleges teach industrial design in some measure, generally as part of an art course. A notable exception is the Georgia Institute of Technology, with a curriculum that includes engineering chemistry, mechanics, materials, design, and mathematics, and leads to the degree of Bachelor of Science.

The Society is endeavoring to develop a basic curriculum which will strengthen the designer's engineering knowledge. This step is in the right direction, so far as power plants are concerned, and recognizes that the complete industrial designer is not strictly a merchandising specialist, but must work with a synthesis of shape, material, and function. Otherwise, he will fail.

We do not as yet see any likelihood of pink panties being fitted to our smokestacks, or the fluttering of ruffles on our water columns, but these might come. It is all up to the industrial designers, and some of these people have quite active imaginations.

One thing is sure: if ever we do inherit such frills, there will be sound engineering reasoning behind them, and we probably will like 'em.

We are pleased to acknowledge the courtesy of the following companies in granting permission to use their photographs: Fig. 1, Westinghouse Electric Corp.; Fig. 2, American Engineering Corporation; Fig. 3, General Electric Company; Fig. 5, Libbey-Owens-Ford Glass Company.

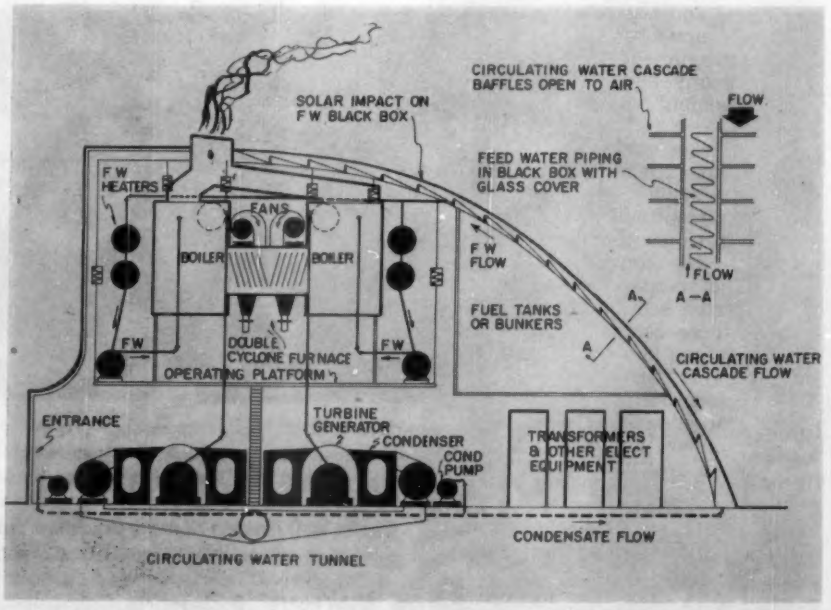


Fig. 6. A concept of power plant housing combining aesthetics and engineering

Power Engineers Discuss Bright Future at ASME and Power Show

American Society of Mechanical Engineers held 1954 Annual Meeting November 28–December 2 in New York. Over 5000 attended. Grand Central Palace was no longer available, so 21st National Power Show moved temporarily to Commercial Museum, Philadelphia, December 2–8, 1954. (It will be back in New York in 1956.) POWER ENGINEERING editorial staff, camera in hand, covered both affairs and on these pages are some of the results

At the ASME meeting, Alex Bailey, former ASME president and retired vice-president of Commonwealth Edison Co., left, greets A. C. Pasini, of The Detroit Edison Co., ASME director-at-large, chairman new Nuclear Engineering Div.

At ASME (l to r), Clarence E. Davies, ASME secretary, watches as Lewis K. Sillcox, 1954 president, hands over gavel and office to D. W. R. Morgan, incoming 1955 president. Far right, Frederick S. Blackall, past president ASME

Left — At ASME President's Luncheon (l to r): Mrs. C. M. Hickox, president Women's Auxiliary; Lewis K. Sillcox, 1954 president; Frederick S. Blackall, past president; Harry R. Westcott, consulting engineer, who presented ASME awards to members

Center — D. Robert Yarnall, president Yarnall-Waring Co., left, and Chester R. Earle, executive editor, POWER ENGINEERING, discuss an ASME technical paper at the meeting

Right — W. F. Ryan, vice-president, Stone & Webster Engineering Corp., left, and Theodore Maynz, consulting engineer, of Philadelphia, at the ASME meeting

Left

E. H. Barry, left, mechanical engineer and Alton Kirkpatrick, assistant chief mechanical engineer, both of Stone & Webster Engineering Corp., of Boston

Right

Famous Lionel S. Marks, second from left. Others (l to r) are: Mary F. Skubik; Mrs. Robert H. Bacon; J. T. Rettaliata, president Illinois Institute of Technology

Left

At ASME (l to r), A. R. LeBailly, Sargent & Lundy; E. G. Bailey, Bailey Meter Co.; Alf Kolflat, also Sargent & Lundy

Right

L. to r.—R. H. Morris, editorial director, POWER ENGINEERING, talked things over with: E. B. Ricketts, formerly Consolidated Edison; H. A. Johnson, Gibbs & Hill

Left

L. to r.—Igor J. Karassik and T. W. Edwards, both of Worthington, confer with E. B. Skubik, associate editor, *Plant Engineering*, our other magazine

Right

George S. Hendrickson, vice-president, left, and T. E. Bell, sales manager, both Republic Flow Meters Co., at ASME

Left

Ralph Sherman of Battelle, left, and F. S. Malette of ASME's research staff

Right

C. E. Rodenburg of Ford, Bacon and Davis, as he delivered his ASME paper

Left

George R. Morgan of J. E. Sirrine & Co. as he delivered his ASME paper

Right

POWER ENGINEERING'S booth at 21st National Power Show, Philadelphia: R. Y. Fuller, New York District manager (left), and E. C. Prouty Sr., vice-president

Left

Part of over 100 members of Philadelphia Plant Engineers Club, which held dinner, December 2, at Show. Third from right, T. E. Hanson, editor, *Plant Engineering*, our companion

Right

Representing Power Show Advisory Committee, Executive Editor Chester R. Earle, POWER ENGINEERING, welcomes Plant Engineers Club to Power Show

Left

Robert McCaw, rear, presiding at Philadelphia Plant Engineers Club dinner at Power Show December 2. Seated, l to r, are Club members Fred V. Richardson, and Dave Godschall

Right

Editorial Director R. H. Morris talks with plant engineers before the Philadelphia Plant Engineers Club dinner

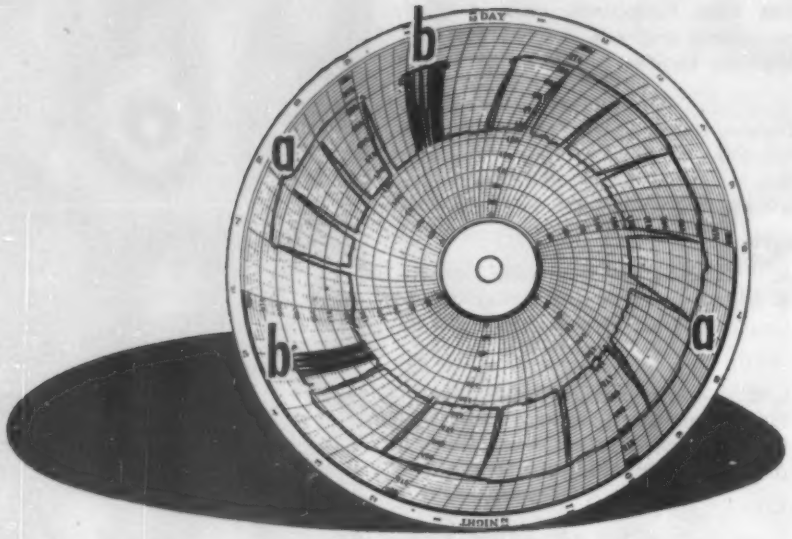


Fig. 1. Trap record. Part "a" shows trap operation for normal boiler conditions. Part "b" shows operation for abnormal conditions, such as high water and priming

How We Stopped All Carry-Over

In Dec. '52 we described how carry-over caused a $250,000 turbine wreck. When the unit was replaced the owner demanded complete protection to prevent a repeat performance. Here's how it was done

By MARION A. JENSEN

A CLIENT who believed that when superheaters were installed in a boiler, no protection from carry-over was required, became the victim of a disastrous turbine wreck only a few months after starting his new plant (see POWER ENGINEERING, December, 1952, page 74).

The management of the new project had been sold on the idea that carry-over could be prevented simply by making sure a uniform boiler water level was maintained. The result was that they bought feedwater regulators, but considered that separators would be unnecessary luxuries, in spite of the engineers' very justifiable recommendations that separators should be installed.

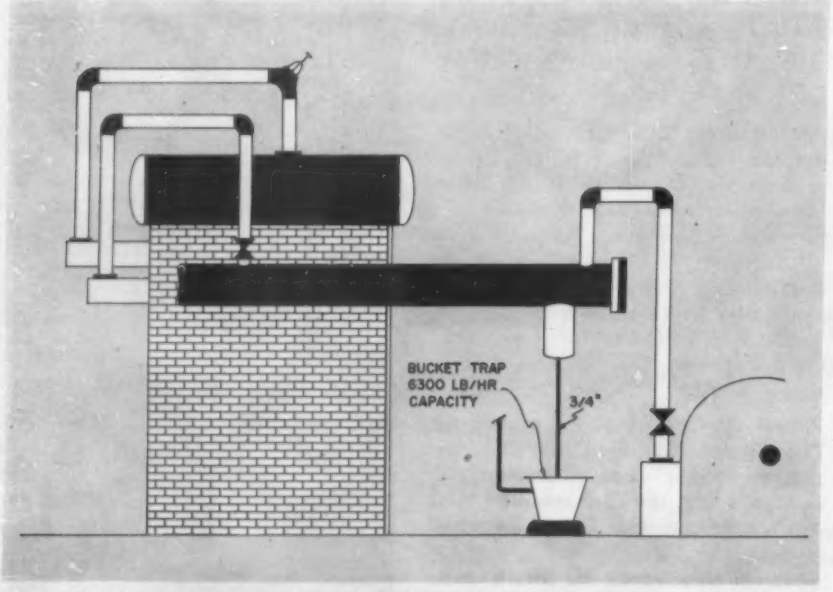


Fig. 2. Original installation, which failed to prevent carry-over. It consisted of a 6 drum steam generator fired by waste gases subject to sudden fluctuations

But the assumption that nothing will go wrong is a dangerous one to make, and less than two months after the plant was first put into service, the feedwater regulator on one of the boilers stuck in the open position. The boiler operator, who should have noticed the incident, but who was busy about his other duties, did not notice that the boiler completely filled with water. By the time this was discovered, the damage was done. In spite of superheater and feedwater regulators, water was carried over and ruined a complete set of turbine blading.

What Shutdown Cost

The plant was out of action for some 30 days while the turbine received a complete set of new blading. The total cost of repairs and lost production time during the shutdown came to more than 20 times the cost of the equipment the engineers asked for in the first place to prevent just this kind of accident.

Only then did we find him a willing listener to the recommendations previously made for protection from such a possibility. In fact, so convinced was this client from his experience — the sum total of which ran into something like a quarter of a

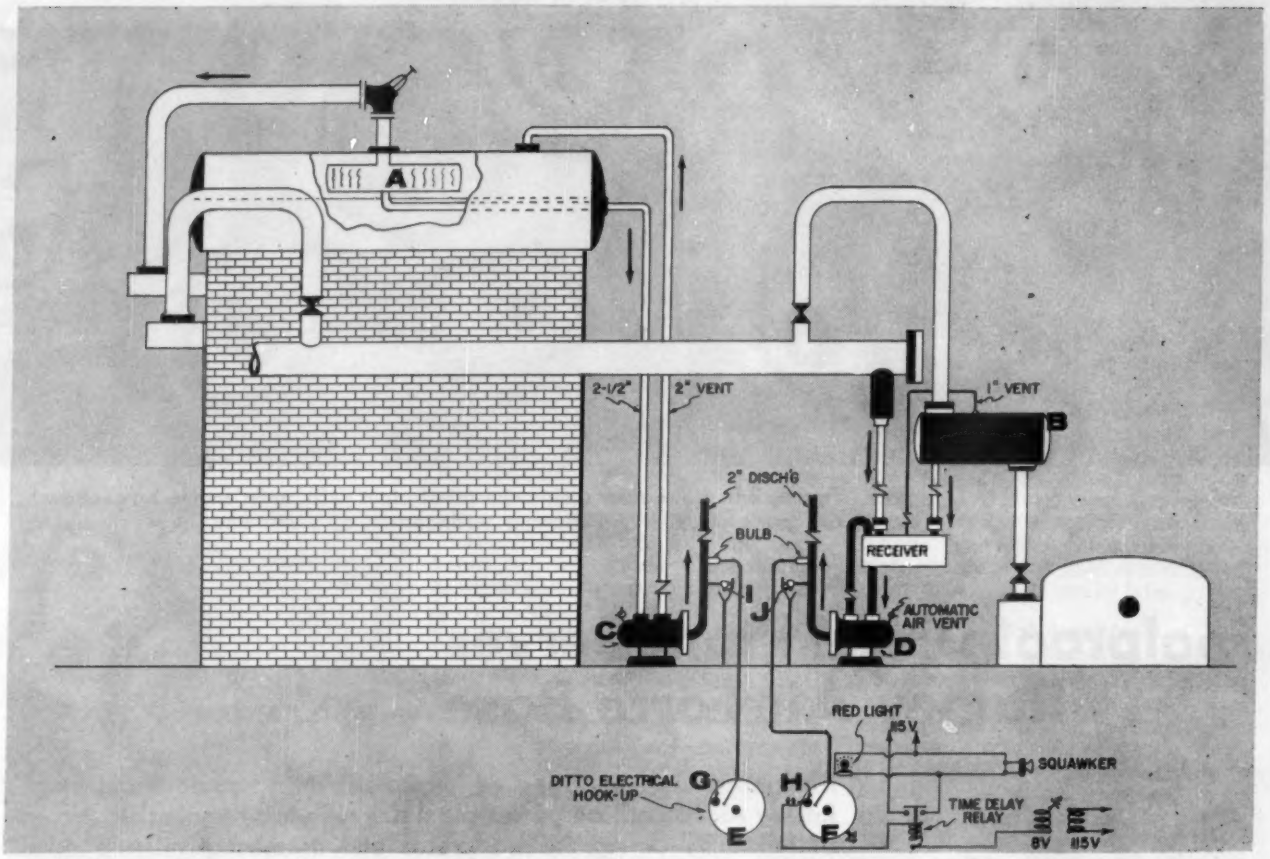


Fig. 3. Diagram shows how the installation was remodeled after the accident to provide as much protection as possible against a repetition of the carry-over disaster. Fig. 1 shows an enlargement of one of the charts shown in the diagram above

million dollars — that he gave us the go-ahead on an installation on the basis that it would embody everything that could be thought of to prevent a recurrence of his trouble.

The original installation, Fig. 2, consisted of a 6-drum, vertical tube steam generator which was fired by waste heat gases released from certain factory processes which were subject to sudden and extreme fluctuations. The base load was carried on a stoker fired unit.

Remodeled installation, Fig. 3, embodied a baffle type of separator, "a," installed in the boiler steam drum.

Ordinarily, we would have considered the installation of such a separator — or perhaps, a self-contained type — as being sufficient. But in view of this client's costly experience and his insistence that we go the limit to insure no recurrence, we decided to include a second separator, "b," Fig. 3.

But no separator, however efficient, is any more effective than the drainage system by which it is served. So we took great pains in the selection and hook-up of the traps, "c" and "d," Fig. 3. Note that the traps are liberally back-vented. This is an important prerequisite to quick filling of traps, such as required in emergency operation.

However, these traps, while having the highest capacity of any we could find, had one serious basic fault: there was no visible or audible indication of their operation. We had had enough practical operating experience to realize that to leave the operating crew without such indication, and without any special precautions, would be risking failure for our installation. So we provided for a continuous graphic record of the operation of the traps together with a visible and audible signal in the event of the danger point having been reached.

Trap Operation Records

A vapor filled bulb installed in the discharge line of each trap served as the actuating medium for the graphic temperature meters, "e" and "f," Fig. 3.

Trap operation under normal boiler operation produced a record substantially as shown at "a-a", Fig. 1, while trap operation under abnormal boiler operation (high water, priming, etc.) would tend to produce a record as shown at "b-b," Fig. 1. In such cases, the meter pen would hug the contacts "g" and "h" with sufficient frequency to enable the time delay relay to close its contacts in the circuit to the squawker and the red lamp over the meter.

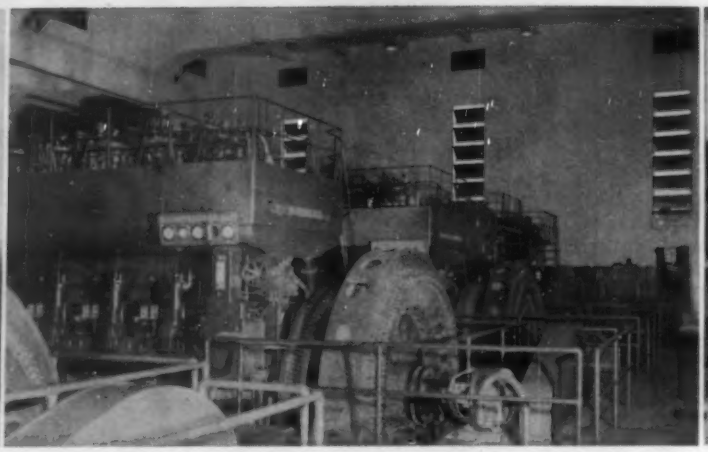
Bleeders, "i" and "j," were installed in the trap discharge lines below the check valves; these were opened just enough to promptly purge the discharge line of any accumulation of vapor that might tend to produce a false deflection of the pen. They also served as a double check on the operation of the trap, and to show leakage of the trap valves.

Experience gained from more than five years of operation with the installation has demonstrated the ability of the boiler separator alone to cope with any degree of carry-over likely to occur. However, the second separator may be considered in the light of an over-speed governor on a turbine — insurance against failure of the regular speed governor.

An additional benefit derived from the installation which we did not figure on at the outset was the complete elimination of deposit in the superheaters, which resulted in a substantial increase in superheat temperature.

The entire cost of the installation was less than 5 per cent of the loss incurred before its installation.

The boiler design, and the methods of operation in this particular case, made it tantamount to suicide to attempt operation without adequate protection from carry-over. However, our experience with many installations over a period of years has convinced us that adequate protection against carry-over in any case is a paying proposition.



Figs. 1, 2 and 3. Ramey's hurricane-proof plant (left), main engine bay (above), and pump room (right) showing arrangement of water and oil system piping

Foolproof Diesel Plant Serves Ramey Air Force Base

By W. O. TATMAN*

Hampered by shortages of materials and trained manpower, Ramey Air Force Base power plant has run up a remarkable record of reliability during the war years and its subsequent expansion

EARLY IN 1938, when the War Department became aware of our need for continental protection, several air bases were begun on islands in strategic locations. These bases, in order to be effective, had to be self-sustaining. Each had its own power plant, sewage plant, water plant, garbage collection and disposal system, and all other facilities required by a group of married and unmarried personnel.

Ramey Air Force Base was one of these island installations. Its power plant, completed at the end of 1941, had one 2000-hp and one 2400-hp, two-cycle, 225-rpm, mechanical injecting diesels, direct-connected to a-c generators, when it first went on the line. A third engine, another 2400-hp unit, went into service in March 1942.

Operating supplies and trained personnel were extremely hard to procure from the first. One of the most critical items was the lube oil supply; on one occasion, we had to drain the oil from one engine to keep the other two operating. Earlier, we had improvised a soda ash batch treating plant for the lube oil from an old 1000-gal tank and miscellaneous equipment. While two engines were running, the crankcase of the third was drained and its oil cleaned. At the same time, we were improvising belts from parachute web straps to drive the centrifuge. The Navy finally gave us much-needed help in alleviating the bad supply situation.

Though plagued by supply shortages and untrained personnel, the plant gave excellent service. In July 1952, when work began on a new addition, the total outage time was 70 minutes; 75 per cent of this was man-failure and the other 25 per cent was due to causes beyond our control. Not one mechanical failure was responsible for a shutdown.

Cooling Problems

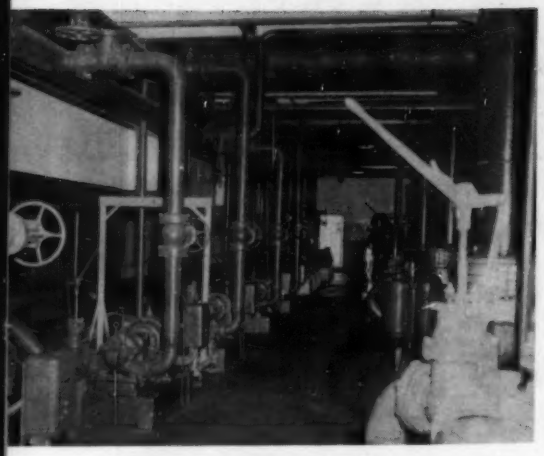
As installed, each engine had its own independent closed cooling system with indoor evaporative coolers. This system soon proved impractical and ineffective. After our engines began picking up load, they could not be maintained cool enough without using large amounts of makeup water and discharging an equal amount of hot water. Also, there was no possibility of applying one engine's pumps to the other cooling systems if one of the other pumps failed. Deterioration of the coolers set in, forcing us to rebuild our fans and housings.

About 50 ft from the engine room, the laundry boiler room was producing hot water at the rate of about 75,000 gal per day. Two 100-hp boilers ran steadily to keep the laundry in hot water and steam. Our cooling problem was solved by piping the jacket water, softened and at 140 F, to the laundry to supply all hot water used there. A spray pond completed the picture — water in the pond being changed once a week so that it never became hard from concentrates.

With the completion of this project, it became possible to take one of the boilers off the line for more than six hours each day, with a resulting saving of over $25 per day in fuel. The new layout also did away with the individual cooling systems, substituting two common 10-in. headers. All jacket water pumps discharge into one of these headers so that any engine can suffer pump failure and still receive coolant from the pressurized line. All heat exchanger pumps discharged into the other header, and all heat exchangers received water from that header. All discharge back to the hotwell. The headers connect at each end through normally-closed valves, but they can be connected by opening either or both valves to help make up flow deficiencies in either line. With this new piping arrangement, opening and closing the proper valves permits any pump to be used for any engine or any purpose.

Also connected to the jacket water header is a 3-in. pressure regulating valve in the soft-water make-up line. This valve is set to open at just the pressure at which the jacket water low pressure alarms cut in. If a jacket water pump goes out, this valve will keep enough water in the header to

*Chief of Utilities, Ramey Air Force Base, Puerto Rico



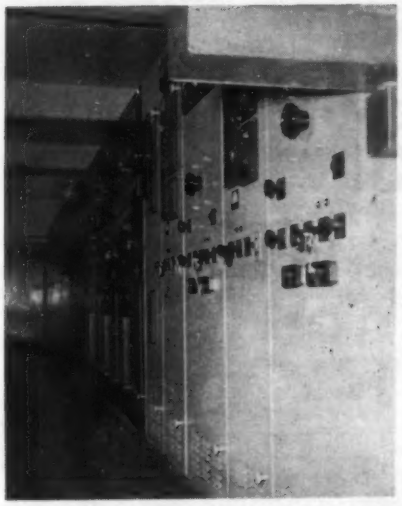


Fig. 4. Switchboard addition (above) is in area formerly occupied by washrooms

keep the engines running until corrective measures can be taken. To complete the flexibility of the system, two 10-in. suction lines were brought into the engine room from the spray pond by different routes and connected through valves to form a loop system. Thereby, one section of the loop can be cut out for repairs when necessary.

All pumps except one in the spray pond are remote-controlled from the engine room, and the spray pond pump is controlled by a float switch in the hotwell. This switch is so set that high water in the hotwell starts the pump and allows it to run until the well is down to the one-third-full mark. This holds the pond water to about 125 F. Part or all of the return water from the engine can be bypassed directly to the spray pond if necessary.

Fuel Handling

Fuel oil is delivered in tank cars on an unloading track, where we can unload five cars simultaneously. All fuel oil used on the base is the same as that used in the plant, which allows joint storage of base and plant oil. Fuel flows by gravity from the tank cars through filters to underground storage tanks. It can be pumped to the power plant and the laundry from storage, but is delivered to other users by tank truck.

Each engine has its own day tank on the engine room mezzanine. These tanks carry enough fuel to run the engines about four hours at full load. This level is maintained by float switches. Tanks are interconnected so that any tank can fuel any engine; or, with all the valves open, all tanks float on the line and comprise a single reservoir. Fuel consumption, however, is metered individually at each engine.

Electrical Features

Station service emergency power is furnished by an 85-kw diesel generating set — also using the same fuel. It is started by throwing a double-throw switch. All plant auxiliaries can be put on this source if necessary. Commercial power is also brought into the switchboard from the local utility with the agreement that they help us when needed and that we help them if needed.

Switchgear is mounted on the metal-clad dead-front switchboard. One end of this board contains the engine controls, while the other end contains the utility tie panel, station service panel and distribution panel. All power leaves the plant underground at generator voltage. Power factor is good since about two-thirds of the load is for heating or lighting. Heating duty includes all water heating and cooking in the quarters, barracks, mess halls, clubs, hospital, and post exchange. The remaining one-third, after heating and lighting, is for power.

When two new 2400-hp diesels were installed in 1952, it was necessary to knock out some walls and do extensive remodeling to locate the new switchgear next to the old. One isolating panel, two circuit panels and a transition panel were located on the circuit end of the old switchboard, and outdoor switchgear was used for the other circuits. All the new switchgear is electrically operated.

Synchronizing of the new units is either manual or automatic. One switch on the isolating panel cuts out the new section, and the same switch can reconnect the new section. The transition panel feeds the outdoor switchgear.

Preventive Maintenance

Reliability is the paramount need of this plant. Since we have a large labor turnover which keeps the plant operating with green local help, we must take care to be prepared for manfailure. The plant has been made as foolproof as possible, primarily by providing alternate equipment for each job. In this way, the engines can be kept running while repairs are being made on anything but the internals of the engines themselves. Alternate systems or equipment must be capable of extended operation because of the time required to get materials from the United States.

Periodic inspection and preventive maintenance schedules have been set up to guard against unexpected mechanical failures. Each piece of plant equipment is inspected, cleaned, oiled, measured for wear, and reset and repaired if necessary or if called for by the maintenance schedule at that time.

The schedule is controlled by a set of cards numbered from 1 to 52 for each week in the year. On each card is the inspection to be made and the work to be done that week. The chief engineer pulls the appropriate card and makes out work orders for each item found there. These are passed to the assistant chief, who is in charge of maintenance, for assignment to specific maintenance men. At the week's end, the card is placed at the back of the pack where it will come up again 51 weeks later.

Card System

Each work order is numbered and dated and covers only one item. Remarks concerning conditions found, corrections made and materials used are entered on the card by the workman, who then signs the card. The assistant chief transfers this data to a larger history card for the particular equipment item. History cards would contain, for example, the life story of a particular piston in a particular engine; i.e., the number of times removed, the number of rings used, and the condition of rings and ring lands when removed are listed.

Our log sheets were designed to include only those parts of other such logs as we found practical; the log is one which our men can fill out easily. The chief engineer makes out a monthly log from the daily log. This totals up the running time of each engine to that date, the total kwh generated each day, maximum and minimum loads and their times, total kwh per gal fuel, and the number of gallons of fuel, lubricant and cooling water used that day.

This sheet has been invaluable in comparing load demand against base operations. It also gave us the necessary information to compile justification for our request for additional power units to meet expected new base activities.

Our old engines have over 61,000 hours of operation now and are generating between 13.00 and 13.35 kwh per gal fuel. Generation has increased from 8250 kwh the first day of operation to about 74,550 kwh per day at this time. In over 448 months, 24 hours each day, we have never had a major breakdown and have had only one lost-time accident.

Editor's Note: Considering the untrained help available in the area, we believe this record an indication of excellent management of both the technical and human elements of the modern power plant.

Fig. 1. A new shift at tunnel portal ignores the 7200 gpm flow of 107 F water

For additional data on methods used for treating the electrical equipment write the Editor or write TECOLOTE on the postcard bound elsewhere in this issue

Tecolote Discourages Men and Kills Machines

In this hellhole, noxious gases, heat and steam corrode men and metals; compressed air is used three times, motors operate under water and all electrical gear needs special processing

Fig. 2. In the main pump room, air is 96 F sat. and pumps handle 109 F water. The motor, right foreground, new and untreated, burned out in 3 weeks; rewound and treated with Safe-T-Seal it is still running after many months under these bad conditions

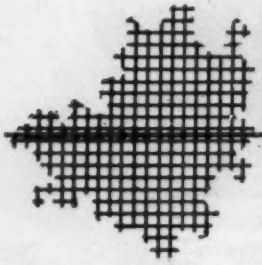
Fig. 3 — Right. Chief Elec. Kubsch reconditions all switches and starters on a 3-week schedule to prevent emergencies

TECOLOTE is a 6.4 mi Bureau of Reclamation tunnel project under California's historic San Marcos Pass. It will carry water from Cachuma Reservoir to the Santa Barbara area.

Due to excessive temperatures and noxious, irritating gases mixed with steam, men could work only 10 min. stints in the bad sections. Only machines made work possible at all.

Rock and water temperatures reached 117 F with water flows of up to 9100 gpm, sufficient in itself for a good-sized city. The air throughout is like a Turkish bath. Main transformers were changed three times to keep up with the pumping load. The air compressor plant is four times that normally used on a job of this size. Air at 125 psi drives pumps. The cool exhaust blows directly on electric motors and then supplements low-pressure blower air for ventilation.

Without electricity all work ceases and yet the electrical end was the most vulnerable part of the system. Transformers filled with condensation and shorted; motors burned out within a day to a week; switches and motor starter were junked in three weeks; telephone equipment failed to work after days. The solution to this almost impossible working condition was a rigid replacement and reconditioning schedule, complete treatment of all electrical equipment with a sealing compound, coating all contacts with heavy grease, and constant vigilance. Even the locomotive motors treated and with auxiliary air compressors will operate when frequently submerged.



Graphical Boiler Heat Balance

By PAUL J. GROGAN *

Beginning with Loss Due to Moisture in Air, December, author will explain each factor in heat balance, with work-saving charts. For No. 2 Chart, turn page

2. Loss Due to Unburned Carbon in Refuse

DETERMINING the heat units lost per pound of fuel due to unburned carbon has been complicated in recent years by the increase of spreader stoker and pulverized fuel firing. These methods of suspension burning have greatly advanced the art of combustion engineering, but they have also introduced difficulties through the tendency for certain combustible and ash to carry through the steam generator as fly ash.

When a furnace is fired with a pound of fuel, the carbon in that pound of fuel is consumed in the formation of carbon dioxide and carbon monoxide, or it is lost in any of three forms of unconsumed carbon: carbon in the ash pit refuse; carbon in the collected fly ash; and carbon in the escaped fly ash.

Generally the fly ash will be nearly one-half carbon by weight. On the other hand, the ash pit refuse is usually low in carbon content. The latter is especially true in the instance of pulverized fuel firing.

Although relatively exact methods are close at hand, several practical assumptions may be made to simplify your particular situation.

In stoker service, excepting certain spreader stoker installations and circumstances when a stoker is forced beyond its normal rating, the fly ash and therefore the carbon in the fly ash is a relatively small quantity when compared with the amount of carbon in the ash pit refuse.

In pulverized fuel firing, the opposite situation to the above exists in that the unburned carbon item is largely due to the carbon which is a part of the fly ash.

In gas and oil firing, in the absence of heavy smoke, the unburned carbon item is of small consequence.

For stoker firing without significant fly ash, two methods of finding unburned carbon are available:

1. For the test period, the total refuse is carefully collected and weighed. This method necessitates starting and ending the period of test with a clean ash pit and furnace, or at least comparable conditions should be duplicated. The weight of refuse per pound of fuel fired is readily determined from the knowledge of the fuel burned and the refuse collected during the test. The weight of ash per pound of fuel is known from the as-fired fuel analysis. The difference, refuse minus ash, per pound of fuel, must be the unburned carbon, C_r.

2. An alternative is to collect a representative sample of the ash taken at several times and places during the test period. It follows then:

$$C_r = \frac{\text{lb unburned carbon}}{\text{lb fuel}} = \frac{\text{lb. ash}}{\text{lb fuel}} \times \frac{\text{lb. carbon in refuse}}{\text{lb ash in refuse}}$$

Where the pounds of ash per pound of fuel is simply taken from the proximate or ultimate analysis of the fuel as fired, the second ratio on the right, pounds of carbon in the refuse per pound of ash in the refuse, is determined from the refuse analysis. The method presupposes no appreciable fly ash, which permits cancellation of the units on the right, "lb ash" and "lb ash in refuse." The resulting term "lb unburned carbon per lb fuel" and "lb carbon in refuse per lb fuel" are considered synonymous when little or no fly ash is emitted.

Where Fly Ash Is A Factor

In pulverized coal firing, the problem is to determine the distribution of ash between the refuse pit and the fly ash collection system. In general, a significant amount of fly ash escapes even the better arrangements for its collection. Therefore, a material balance of the ash should be made first. It may be stated thus:

$$A(\text{by fuel analysis}) = A(\text{refuse pit}) + A(\text{fly ash})$$

Ash in the as-fired fuel analysis and ash in the refuse pit both may be determined to a good degree of accuracy. The difference between the two, then, must be that portion of the ash which attempts to escape via the flue gas route. Again, one may strike a material balance for the ash in the fly ash:

$$A(\text{fly ash}) = A(\text{collected}) + A(\text{escaped})$$

By weighing and analyzing the fly ash which is collected, the above equation may be solved for the amount of ash which escapes the collection system. Hence, a good determination of the collection efficiency is also possible through these methods. It is assumed that escaped ash will have the same composition as that trapped, therefore:

$$\frac{\text{lb carbon in fly ash}}{\text{lb fuel}} = \frac{\text{lb ash in fly ash}}{\text{lb fuel}} \times \frac{\text{lb carbon in fly ash}}{\text{lb ash in fly ash}}$$

and

$$\frac{\text{lb carbon in refuse}}{\text{lb fuel}} = \frac{\text{lb ash in refuse}}{\text{lb fuel}} \times \frac{\text{lb carbon in refuse}}{\text{lb ash in refuse}}$$

The general solution for the unburned carbon problem appears in the last two equations above. Note that the equations are parallel. The former applies to carbon in the fly ash and the latter applies to carbon in the ash pit refuse. From them the following may be determined:

$$\frac{\text{lb unburned carbon}}{\text{lb fuel}} = \frac{\text{lb carbon in fly ash}}{\text{lb fuel}} + \frac{\text{lb carbon in refuse}}{\text{lb fuel}}$$

Having determined the magnitude of the unburned carbon per pound of fuel by the particular method which applies, the actual carbon burned per pound of fuel (C_b) may be determined readily by the balance method:

$$C(\text{ultimate analysis}) = C(\text{burned}) + C(\text{unburned})$$

$$C = C_b + C_r$$

Relations Charted — Next Page

Example 1: Assume a fuel is fired containing 10 per cent ash (refer to Point A). The refuse analysis indicates 20 per cent carbon in the refuse (refer to Point B). The pounds of carbon in the refuse per pound of fuel is read at the left as 0.025 pounds (refer to Point C). Going to the right to the heavy reference line (Point D), and then up to the scale at the top, read the loss due carbon in the refuse 365 Btu per pound (Point E).

Example 2: Assume another example in which the terminology is changed. A material balance of the ash fired to a pulverized fuel unit indicates that 0.03 pounds of ash are in the fly ash per pound of fuel (refer to Point G). The portion of carbon in the fly ash by analysis is 55 per cent (refer to Point H). The pounds of carbon in the fly ash per pound of fuel is 0.0367 (Point J), and the loss due to carbon in the fly ash is 535 Btu per pound (via Points K and L).

The methods of Examples 1 and 2, when combined, represent the solution of the unburned carbon item and its attendant loss where both the ash pit refuse and the fly ash have been considered.

* Chairman, Department of Engineering, and Director, Engineering Institutes, University Extension Division, University of Wisconsin. All republication rights reserved by author.

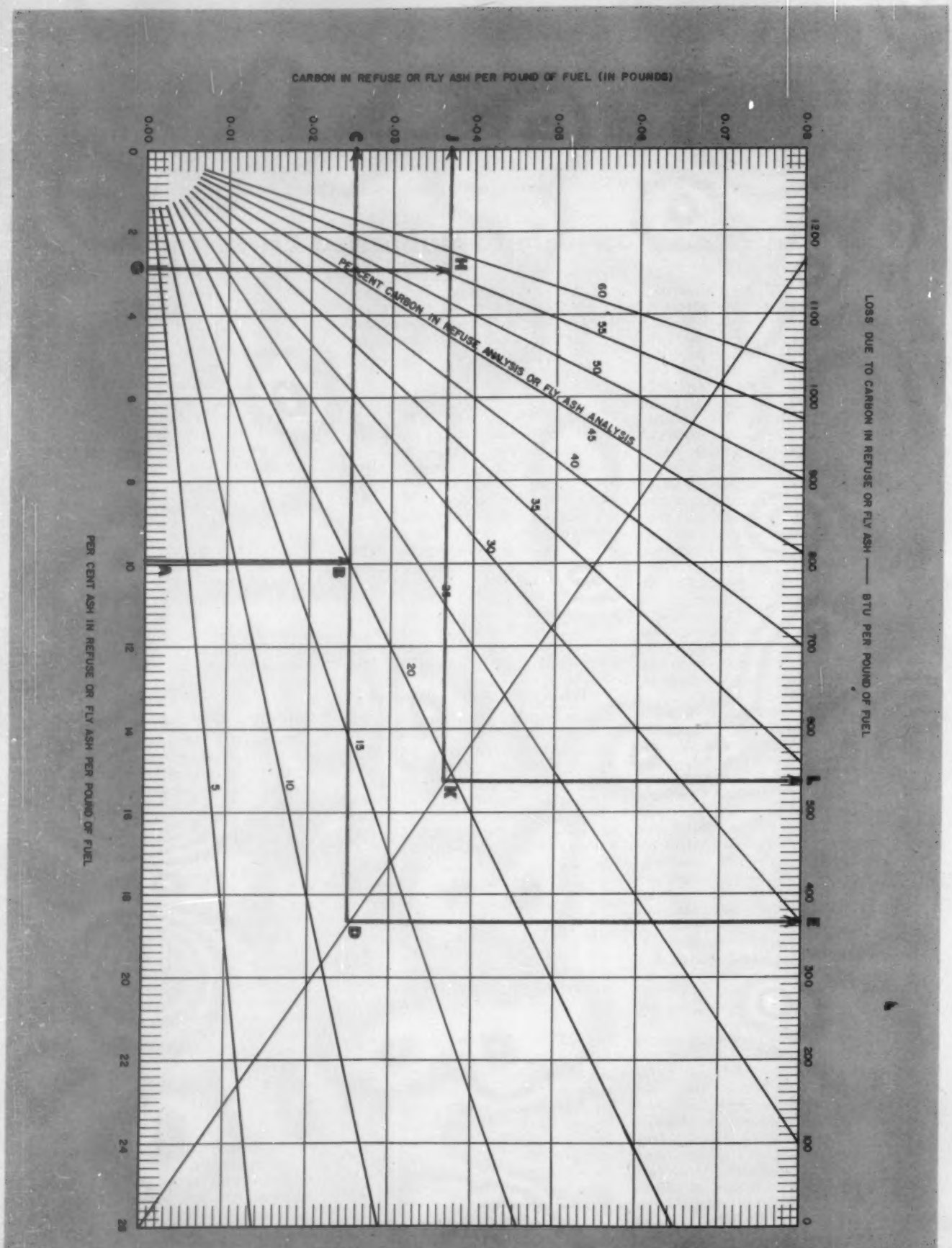


Chart of Unburned Carbon Losses

(Text on page 99)

Which Costs Less—Planned Overhaul or Emergency Shutdown?

You can run your equipment till it busts and then repair it, or you can give it planned overhauls to prevent failure. Either way it will cost you money. Here's how to find out which costs less

By L. A. BECK*

SOME MAINTENANCE departments say "Run the machine till it busts, then we'll fix it up quickly enough." This point of view has a curiously wide appeal, and since it is easy to show that this practice is nearly always more expensive than productive maintenance, there must be some reason why so many maintenance departments continue to run machines till they break down before doing anything about them.

Here are a couple of reasons which may explain why the "wait till it busts" method still has a wide appeal.

Not only does human laziness make it easier to let a machine run on instead of taking the trouble to plan and prepare for a scheduled shutdown, but when an emergency does occur, the excitement and sense of urgency of the work make it more enjoyable than the dull routine of a planned overhaul. We have all met men who were just average workmen on ordinary jobs, but who would work like beavers, day and night, when faced with the urgency of a plant shutdown. This kind of work is more exciting than routine maintenance, and it may influence people in their approach to productive maintenance.

If this explanation is incorrect, there must be some other good reason why many maintenance departments do little productive maintenance, since its advantages in dollars and cents can be demonstrated very easily, for any piece of equipment, by using the form shown above.

The top half of the form gives general information about the equipment, while the lower half compares the cost of overhauling it at *your* convenience, when the shutdown can be scheduled to give a very small production loss, against the cost of repairing it when it breaks down at *its* convenience, which is usually the worst possible time for you.

The actual time taken for an overhaul will be about the same whether it is routine maintenance or an emergency. The emergency job may be a bit quicker, but any savings here will be more than offset by the cost of overtime, lost manhours when men are transferred at short notice to the emergency, and other expenses associated with an emergency.

The biggest cost will nearly always be loss of production during the shutdown, and production loss will nearly always be less for a planned overhaul than for an emergency shutdown. By completing the chart as shown herewith, for any particular machine, you can quickly estimate how much money will be saved by making a planned overhaul instead of letting the machine run until it breaks down.

EVALUATION OF PLANNED OVERHAUL REQUIREMENTS

DATE _____

LOCATION _____ DEPARTMENT _____ MACHINE NO. _____

MACHINE RATING _____

AGE SINCE INSTALLATION OR LATEST OVERHAUL _____

OPERATING CONDITIONS (ATMOSPHERE-TEMPERATURE) _____

HOURS OPERATION PER DAY _____

ELECTRICAL CONDITION READINGS _____

CONDITION OF INSULATION _____

MECHANICAL CONDITION _____

POSSIBLE RETIREMENT OR REPLACEMENT OF MACHINE _____

PRODUCTION TIME LOST FOR PLANNED OVERHAUL	TOTAL DOWN-TIME COST	COST OF PLANNED OVERHAUL	TOTAL PLANNED OVERHAUL COST
_____DAYS	$_____	$_____	$_____

PRODUCTION TIME LOST IN EVENT OF MAJOR FAILURE	TOTAL DOWN-TIME COST	COST OF REPAIR & PARTS	TOTAL FAILURE COST
_____DAYS	$_____	$_____	$_____

Form may be used to compare the total cost of a major failure (where there has been no planned productive maintenance) with total cost of a planned overhaul

Another difficulty in persuading maintenance departments to believe in productive maintenance concerns the ordinary life cycle of machines. On most motor and generator installations, failure rates may be high at first due to faulty design, installation, or initial operation. But after the first year or two there will usually be a period of 15–20 years during which the machine will operate satisfactorily with very little maintenance. Then comes the period of old age, with failures becoming more and more frequent.

Many maintenance departments have come to regard this as a normal cycle, not realizing that it is because they neglect the motor during its good years that it gives them so much trouble in its old age. If, during the good years, they had looked after it with a program of routine day-to-day inspection and maintenance, and with planned long-range maintenance whereby motors are taken out of service, tested and rewound or rebuilt before actual failure occurs, they would find that their machines would repay this kindness by many years of trouble-free operation even when they are old.

Another advantage of planned maintenance concerns the livelihood of maintenance personnel. Neglecting a machine for years and then trying to repair it when failures become frequent, means that you do little work while the machine is young, and then you have more work with it than you can handle when it grows old. With a planned maintenance program, work is steady throughout, men do not have to be laid off for work fluctuations, and production can be maintained at a high level.

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Fig. 1. (Above) View of boiler room showing damage and debris after the explosion. Three men were killed by missile

Fig. 2. (Right) Shows position of boiler shell where it finally came to rest 126 ft away from its foundation in boiler room

Another Misguided Missile . . . This One Hurt!

Last May we reported a jet propelled acetylene cylinder that travelled 1500 ft before landing. At that time no one was hurt. Now here's an H.R.T. boiler doing the same thing, but with tragic results. It killed three men in its path and caused enormous damage

EARLY ONE MORNING last April at a packing plant, an H.R.T. boiler suddenly rocketed forward from its foundations, pierced several heavy masonry walls, and came to rest on the other side of the plant. The fireman on duty and another employee directly in the path of the heavy missile were killed instantly. A third employee was critically injured and died the following day. Many other employees received burns and injuries from flying debris.

The boiler traveled at a terrific speed in an almost flat trajectory, not touching the ground until it landed in the slaughter room 126 ft away. Its path is shown in Fig. 2.

The wrecked boiler was about 30 years old, and had been allowed a working pressure of 100 psi. It was 72 in. diam by 18 ft long, contained 70 four-inch diam tubes, and was a standard type for hand coal firing.

When examined after the accident, the shell appeared to be practically undamaged, but had been stripped clean of all appurtenances except for one safety valve. This valve seemed to work freely when the lifting lever was pulled. The fusible plug in the boiler was found to be intact. However, both front and rear tube sheets had bulged out about two inches, and all the tubes had been pulled out of the rear tube sheet. The tubes were tight in the front tube sheet and the beading was intact; the diagonal braces appeared to be sound, and the stayed portions of the heads were undistorted except for a few dents in the front head caused by striking the masonry walls in its path. The tubes were sound and undistorted, and there was no excessive pitting or corrosion. It was apparent that the tubes had been beaded at the rear tube sheets before they pulled away. The tube sheets seemed to be in good condition but stains on them indicated there had been some recent leakage.

It was learned that a rupture of the blowdown line from the boiler had caused an emergency shutdown of this boiler four days before the explosion. The fire was immediately pulled at that time and the boiler apparently suffered no damage. The fact that the fusible plug in the boiler was still intact evidently convinced the operators that no serious overheating had occurred.

The boiler had been idle until it was fired up the night before the accident. Apparently no difficulty was experienced with its operation during the night. It is not definitely known what caused the explosion, but in the opinion of the Mutual Boiler and Machinery Insurance Inspectors, given in a recent issue of *The Condenser*, overheating of the boiler may have occurred when the blowdown line ruptured earlier, causing the tube ends in the rear tube sheet to soften and lose their holding power. This opinion seemed to be confirmed by the tight tube joints at the front head. Upon bringing the boiler up to pressure on the morning of the failure, the already weakened tube ends may have pulled completely out of the tube holes, releasing the energy which jet propelled the boiler from its setting.

Why the fusible plug failed to melt is hard to explain, but it is possible that it was protected from intense heat by scale on the internal surfaces, and on the outer surfaces by dislodged or improperly installed refractory.

This accident emphasizes the importance of a careful examination of any boiler following loss of water or possible overheating. A hydrostatic test following rupture of the blowdown line might have indicated the loss of tube holding power at the rear tube sheet. Another important point brought out by this accident is that fusible plugs do not constitute a guarantee of safety. Theoretically fusible plugs are fine, but there are so many ways in practice that they can be prevented from working properly, they should not be relied on too heavily.

cut along this line

As a rule, the reheated steam has a temperature only a little below that of the primary steam but the pressure is considerably lower. As an example, the primary steam may have a pressure of 1400 lb per sq in. and a temperature of, say, 1050 F. After this has passed through a number of stages in the turbine it is extracted at, say, 200 lb per sq in. where its temperature will be around 400 F. In the reheat section of the boiler this steam will then be heated to a temperature of, say, 1000 F. Its pressure, however, will still be 200 lb per sq in.

So now we have both superheat, reheat, and regenerative feedwater heating in our system and it is becoming very efficient, as steam cycles go. With systems of this kind thermal efficiencies of around 32 per cent can be obtained, that is, some 32 per cent of the heat energy in the fuel will be converted into electrical energy.

You may wonder why this figure is so low. The reason, as implied earlier in this treatise, lies in the fact that most of the heat is carried away by the condenser cooling water. Unfortunately, this low efficiency is a consequence of the second law of thermodynamics and there is practically nothing that engineers can do about it. If the temperature of the steam at the exhaust of the turbine could be brought down to absolute zero, we could recover most all of the heat energy in the fuel but since we live in a world where the ambient temperature is some 490 degrees F above absolute zero there is no way by which we can ever reduce the temperature of the exit steam below ambient temperature. Of course, we could do it by refrigeration but the refrigeration system would require power and so we would gain nothing, indeed we would lose efficiency.

We have now incorporated in our system about all the known methods for improving the efficiency. Further improvement can be made in any system by going to still higher pressures and temperatures, by refinements in the condensing system, and by the further reduction of heat losses wherever they occur by improved equipment, insulation, and recovery of minor wastes, but the gains to be expected by these means are relatively small. In large power stations, however, each increment, each fraction of a per cent in the overall efficiency is worthwhile because such stations use hundreds of thousands, indeed, millions of tons of coal a year, and even small gains in thermal efficiency reflect large savings in fuel costs. As indicated at the beginning of this discussion, today, modern steam-electric generating stations use less than one third the amount of coal for the same kilowatt output that they did 30 years ago. This saving has been brought about by continual refinement such as described in these pages.

It is obvious then, in the operation of a power station, every effort has to be made at all times to keep the temperatures, pressures, and the vacuum in the condenser at their optimum values. A change in any one of these values affects the efficiency of the system as a whole. In the condenser, for example, the vacuum must be maintained at its highest value by the use of the coldest possible circulating water. Since the circulating water usually is drawn from rivers or lakes, the temperature varies throughout the year, warming up in summer and becoming cooler in winter. Since the condenser is under vacuum there is a tendency for slight air leakage into the system and unless this air is removed it tends to accumulate in the condenser and thus impair the vacuum. So condenser air pumps are provided which continuously remove the air. These pumps separate the air from the water vapor and return the water to the condensate system. These condenser air pumps, nowadays, are of the steam ejector type. Even these are fitted with heat exchangers to recover the heat that might otherwise be lost in extracting the air from the condenser.

One element in power station operation that has received an ever increasing amount of attention in recent years is that having to do with the delivery of pure feedwater to the boiler. Modern high pressure boilers evaporate a million or more pounds of water per hour, and they do this 24 hours a day, 365 days a year. With such tremendous rates of evaporation, it is obvious that if the water delivered to such boilers contained even small amounts of scale-forming materials, the internal heating surfaces of the boilers would soon become so coated with scale that overheating and subsequent failure would result.

Because of this, elaborate systems of chemical feedwater treatment have been

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Power Engineering handbook

A Power Plant Primer

By A. W. KRAMER

IN THE TWO preceding parts of this "Primer", we have evolved a fairly workable steam power plant. We have provided boiler, fans, a choice of firing procedures, economizer, air preheater, turbine, generator, condenser, and pumps. But the plant, while it will operate, could not compete commercially today. It would still use too much coal.

Feedwater heaters using extraction steam reduce the fuel requirements somewhat. Heat that would normally be lost to the cooling water in the condenser is given back to the feedwater.

In this concluding part of the Primer, the present state of feedwater heating practice is discussed with those other factors identifying modern plants.

In heating water or any other substance to a higher temperature, however, only a portion of the total heat necessary need be at the highest temperature; much of the total heat is used in heating the water through a lower range of temperatures. With this fact in mind, it becomes possible to heat the feedwater successively in two or more stages in the manner shown in Fig. 19.

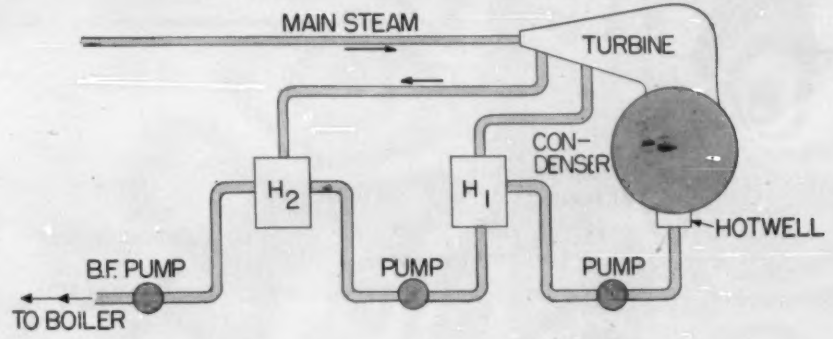

Fig. 19

Now, we have two feedwater heaters, a low pressure, low temperature heater receiving extracted steam from a stage close to the condenser, and another one receiving steam from an extraction point closer to the throttle. Water from the hotwell is first pumped to heater H_1 where it is raised to a relatively low temperature and then it is pumped to the second heater where it is raised to a temperature close to the temperature of the water in the boiler. With this arrangement, it will be obvious, more power can be obtained from the total amount of extracted steam. In other words, by the use of two heaters instead of one, we have increased the efficiency of the system.

So the question arises, if two heaters are better than one, why would not three be better than two, or four better than three? The answer, of course, is yes; each additional *stage* of extraction improves the thermal efficiency. However, in this instance, as in all engineering projects, there is a point of diminishing returns beyond which the further addition of heaters becomes uneconomical. Theoretically maximum efficiency would be obtained by means of an infinite number of extraction points and feedwater heaters. Actually, four or five stages is the economical limit and so most modern power systems are designed for this number. A few of the most modern stations use seven or eight.

The method of heating the boiler feedwater in this fashion is known as regenerative feedwater heating; it is used in all modern steam power generating systems. With such systems a total of 20 to 30 per cent of the throttle steam may be withdrawn from the turbine at various points and used to heat the feedwater (see Fig. 20).

Here in this diagram we have incorporated four stages of feedwater heating in our system. At each heater the water is raised to a higher temperature. Since the pressure in each heater is higher than in the one preceding, a pump is necessary between successive heaters. Finally, after the water passes through the last heater, the boiler feed pump delivers it to the economizer section of the boiler.

It is very evident from this diagram that a steam power plant can become quite complex when we try to take advantage of all the methods available

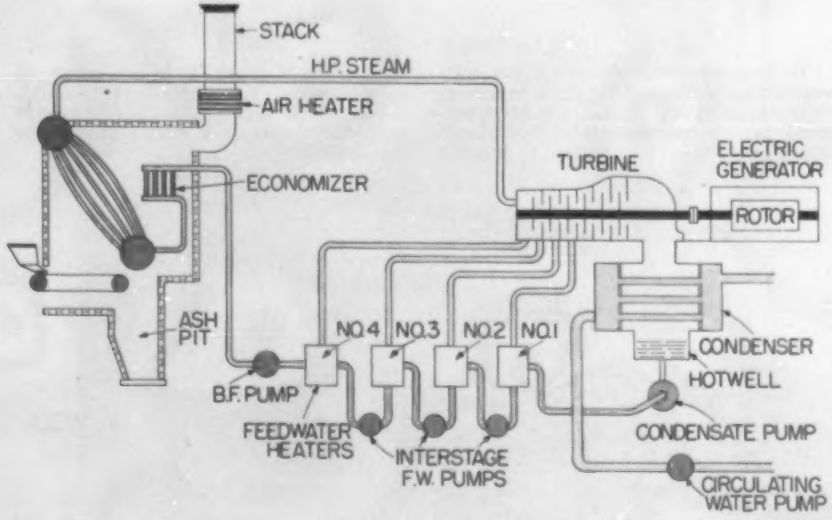

Fig. 20

fold along this line—outside edges toward you

to increase its efficiency. Indeed, the diagram, as shown, is still far from complete. While an air heater is shown, the fans and connection to the air heater have been left out so as to keep the diagram simple. Actually, of course, the air is forced through the air heater by means of a fan, and after being heated it is forced into the furnace as in Fig. 21.

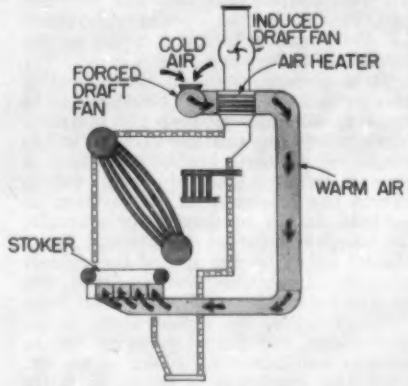

Fig. 21

This shows how the forced draft fan forces cold air through the air heater and how the warm air is forced through ducts (which have to be insulated) into a plenum chamber underneath the stoker. Here it passes through the coal bed and thus supports combustion. A portion of the warm air is also admitted above the fuel bed.

The air heater, it will be noted, is placed directly above the outlet of the furnace. Since it is built of a great many tubes it introduces a certain amount of resistance to the flow of the hot gases of combustion. In older plants where air heaters were not used a tall stack or chimney usually produced sufficient draft to pull the gases out of the furnace but where air heaters are used it has become universal practice to place an exhaust fan in the passage to the stack. Such fans are known as induced draft fans. Since these fans have to handle all the gases of combustion they often are very large and require powerful driving motors; sometimes rated as high as 1800 hp.

The plant as we have now designed it is a fairly good power plant but it lacks several important elements. One of these is a superheater. The purpose of a superheater is to heat steam above the temperature at which it is produced in the boiler. In practice, the superheater is merely an arrangement of alloy steel tubes placed in the gas path through the boiler. After the steam collects in the boiler drum it passes through the superheater tubes and is thus heated to a temperature higher than that associated with the pressure at which it is produced. For example, saturated steam at 1000 lb per sq in. absolute pressure has a temperature of 556 F. (Remember steam at atmospheric pressure has a temperature of 212 deg. F.) Now by passing the 1000 lb per sq in. steam through the superheater, it can easily be heated to a temperature of 200 deg higher, or 756 F. The pressure will remain the same.

Such superheated steam has two advantages over steam that is not superheated: first, it increases the thermal range of the steam cycle, and hence the efficiency; and second, being dryer, it is less likely to condense in the lower stages of the turbine. In large turbines, the formation of drops of water on the blades near the exhaust end of the turbine can be quite damaging. By the use of superheated steam, however, this condensation can be minimized to a point where it is harmless. Hence, all modern power plants use superheated steam, indeed in the most modern plants in addition to the superheater the steam is reheated in a second superheater after it has passed through a portion of the turbine. With such an arrangement steam collected in the steam drum of the boiler passes first through the primary superheater, then through the first few stages of the turbine, then back to the boiler where it is reheated in the reheat superheater, and finally, sent back to the lower pressure stages of the turbine and so, to the condenser. The idea is outlined in Fig. 22.

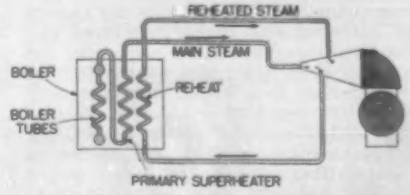

Fig. 22

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developed which not only reduce the scale forming materials to practically zero but also reduce the oxygen content to reduce corrosion. Oxygen in hot water is an extremely corrosive agent. Sometimes these feedwater treatment systems involve evaporators in which raw water is evaporated by steam extracted from the turbine and then condensed. Other systems use ion exchange type demineralizers, or chemical treatment which precipitate the scale forming materials in the form of sludge before it enters the boiler.

Whatever the type of system, the purpose is to add only absolutely pure water to the system. It should be obvious that the amount of water that need be added to the system while it is in operation is small, since all the steam flowing through the turbine is condensed and returned to the boiler. There are small losses; however, these have to be replaced by what is known as *make-up* water. This make-up is the water that has to be treated.

Another factor in the operation of large power stations that has become important is the emission of dust and fly ash from the stacks. In plants where many thousands of tons of coal are burned a day, the emission of fine ash from the stacks can become a serious nuisance and in many communities ordinances have been enacted requiring power stations to reduce the emission of fly ash and dust to a minimum. This has not been an easy problem and many hundreds of thousand of dollars have been spent in developing equipment for collecting such dust before it enters the stacks.

A number of different methods are in use. In one type of system, the flue gases are passed between electrically charged plates. The intense electrostatic field charges the dust particles causing them to be attracted to the plates. After the dust has accumulated to a certain thickness on the plates it is scraped or knocked off. In other systems, the flue gas is whirled through cyclone separators or passed through sprays of water. In any case, whatever system is used, they are expensive and involve high orders of engineering skill in their design.

So far, we have been concerned only with the steam end of the power system; indeed, we have only mentioned the electric generator in passing. This is due to the fact that most of the economies that can be made in the operation of a steam-electric generating station lie on the steam side. The modern electric generator is an extremely reliable and efficient machine. Modern generators have efficiencies of as high as 97 per cent so the additional gains that can be made in the improvement of generators is small.

As pointed out at the beginning of this treatise, basically an electric generator consists of a magnet spinning inside a group of coils of wire. As the rotating magnetic field cuts the convolutions of the stationary coils, electric currents are set up in the coils, and by properly connecting them currents of almost any required voltage can be produced. Modern generators produce current anywhere between 13,000 and 22,000 volts. Where the electricity has to be transmitted over long distances — over 15 or 20 miles, — the generator voltage is stepped up by means of transformers. A transformer is a sort of electrical lever by means of which voltages can be stepped up or reduced to any desired value. Transformers are the most efficient large machines man has yet devised, some of the larger units having efficiencies as high as 99 per cent.

Now, in the light of all this let us finally redraw the diagram of our power plant to incorporate everything we have mentioned. As you see (in Fig. 23) it has become a highly complex affair involving many branches of science — physics, chemistry, metallurgy, thermodynamics, hydraulics, structural engineering, electricity, etc. The drawing has become so large that it has been necessary to put it on a separate double page.

Complex as it may seem, this diagram is still only the simplest of schematic diagrams; an actual power plant layout has in it countless other small and large devices and sub-systems not shown or only indicated on this drawing. For example, so far in this treatise nothing has been said about the combustion control system. This is indicated on this diagram merely in bare detail, showing only the basic devices.

Actually the combustion control system in a large plant would require a large separate drawing since it is very important and the operation of the station would be virtually impossible without it. Essentially it consists of a device which is sensitive to slight variations in steam flow. This device, in

turn, controls a variety of relays and actuating mechanisms which automatically control the flow of fuel, air, and water to the boiler in accordance with the varying load conditions. The primary connection of the combustion control system to the main steam line is shown at A, Fig. 23.

The diagram also incorporates reheat and both high and low pressure turbines. After the steam has passed through the high-pressure turbine, it is returned to the boiler and, after being heated again, it is delivered to the low-pressure turbine. Also, there are two sets of water heaters, three low-pressure heaters taking extraction steam from the low-pressure turbine, and two high-pressure heaters using extraction steam from the high-pressure turbine. Between the two sets of heaters is a *deaerating* heater in which the oxygen in the feedwater is boiled off. Oxygen in boiler water at high pressures is extremely corrosive and must be removed before it is delivered to the boiler. This is done by means of a *deaerating* heater which, in effect, is merely a large tank of water boiling under atmospheric pressure.

The necessity for proper feedwater treatment has already been mentioned. On the diagram, the feedwater treating system is merely indicated. It consists of a chemical treating system feeding into the plant system through an evaporator. Thus, all the make-up into the plant system passes through the evaporator. Thus the make-up water (the water which has to be added to the system continually to replenish water lost by leakage and *blowdown*) enters the system in the form of vapor which is delivered, as shown, to the deaerating feedwater heater. In the evaporator the incoming water is heated by exhaust steam from the boiler feed pump turbine or other steam driven auxiliaries. As already mentioned, a demineralizer may be used instead of an evaporator.

Note that the boiler feed pump turbine receives steam from the main steam header through a reducing valve and a desuperheater. It is not usual to use superheated steam for small auxiliary turbines, for several reasons, first because the metals needed with superheated steam are very expensive, and second, high thermal efficiency is not so important in an auxiliary turbine since the heat in the exhaust is returned to the system. It becomes expedient, therefore, first to reduce the high-pressure steam from the main steam system to a lower pressure by means of a reducing valve and then to *desuperheat* the steam by spraying water into it. In this way, low-pressure, saturated steam is delivered to the auxiliary turbines.

The diagram, it may be noted, shows a symbol labeled "continuous blowdown." Because of the continual recycling of the water through the boiler and because of slight leakages in the system, the boiler water tends to increase its concentration of impurities (scale-forming salts). To keep this concentration to a minimum, it is necessary to blow down the boiler periodically or continuously. In small power plants, this is done periodically by the operator by merely opening a blow-off valve for a few seconds and blowing out the water in the lowest part of the boiler where the concentration is highest. In large plants, the amount of heat lost by such blowdown practice tends to be rather high, so continuous blowdown systems are used. With such systems a small amount of water is withdrawn continuously but before it is run to the sewer, it is run through a heat exchanger in which the heat from the blowdown is transferred to the incoming feedwater.

These are some of the thousand and one details of a modern power plant that make it the complex thing it is. It is not the intent here to consider all these details but merely to point out that they exist. Little has been said about *control* except brief mention concerning the combustion control. The latter, however, constitutes only one element of the station control as a whole. Today, most power stations are controlled from a single control room where quantities from all parts of the plant are measured, indicated, recorded and integrated.

The modern generating station is one of the most completely automatic systems man has devised; it has to be because it would be virtually impossible for operators to watch and accurately control all the varying quantities involved in the operation of a plant. Indeed, it has become impossible to keep track of all the pressures, temperatures, liquid levels, speeds of all the various machines and recently a completely automatic supervisory system for recording and announcing all the hundreds of items involved has been de-

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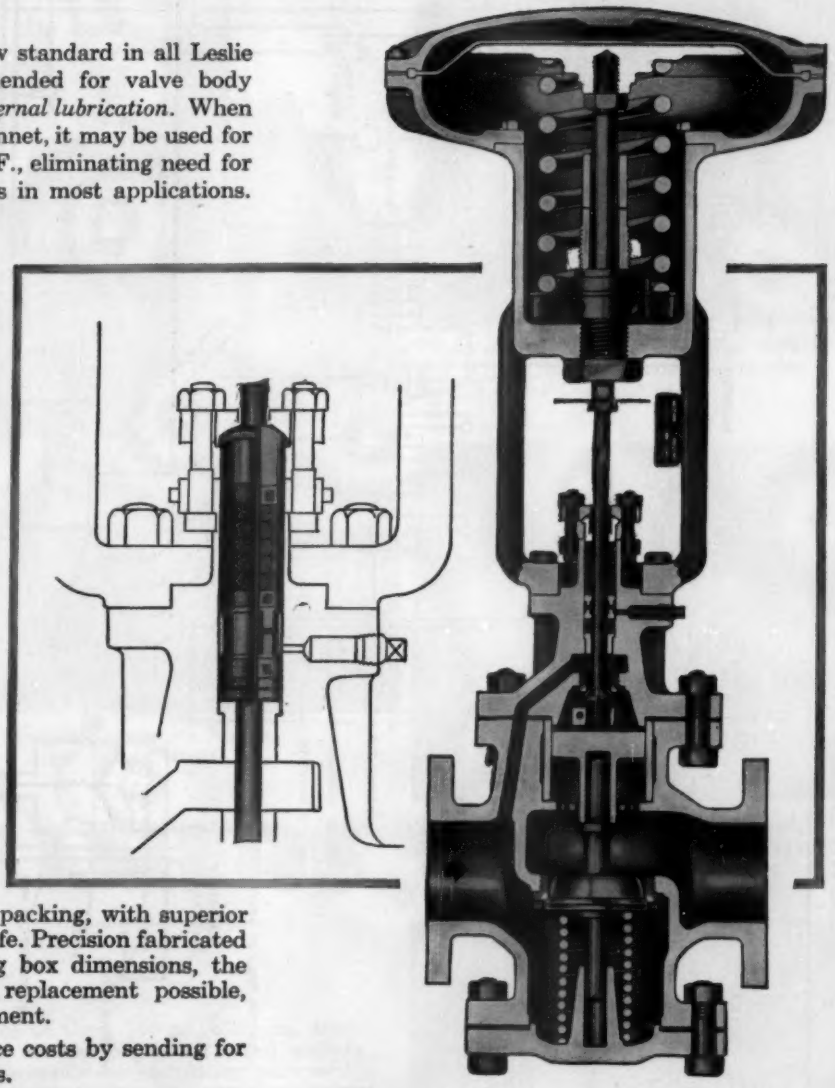

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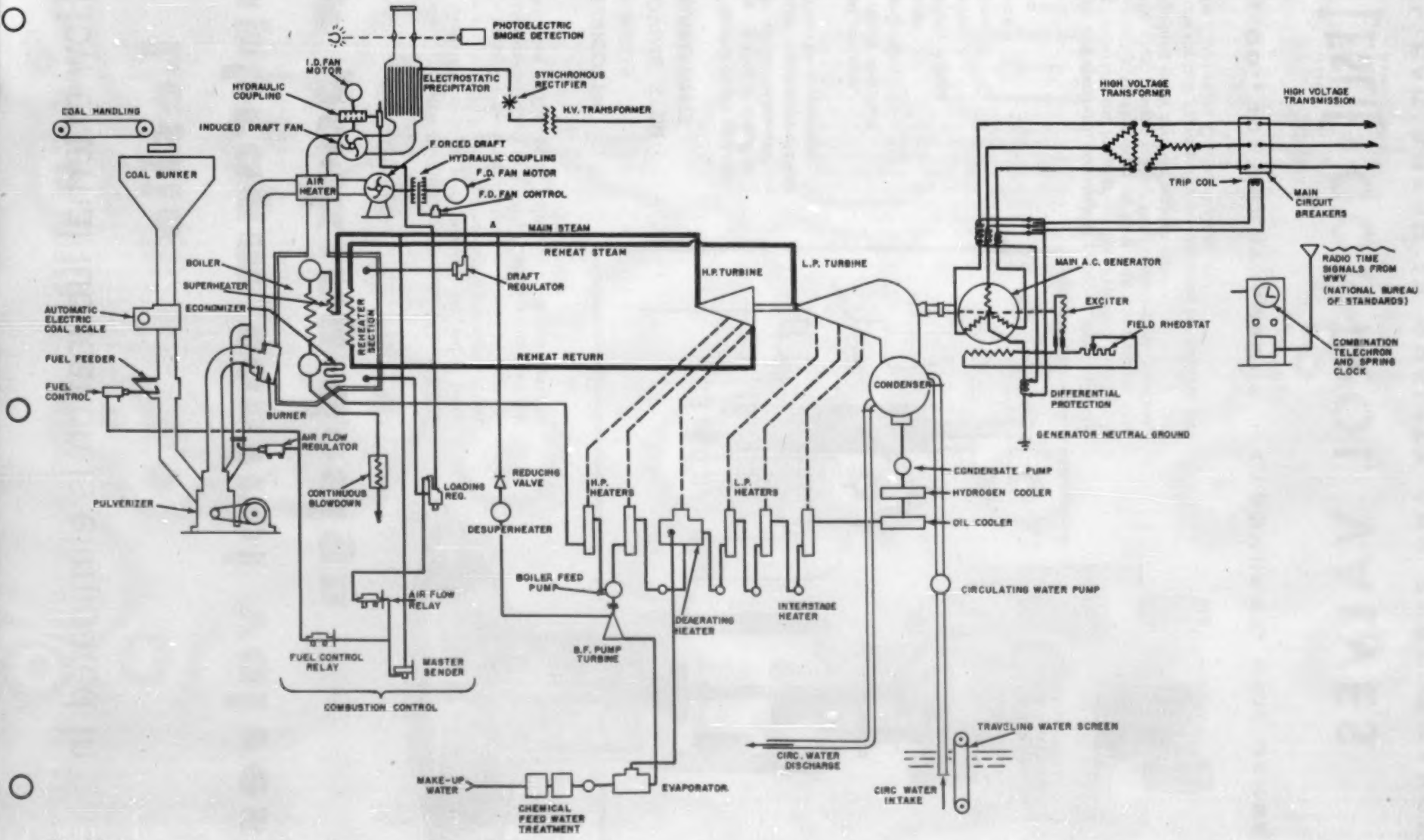
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Fig. 23

What are they using at Meramec?

Another utility uses Allis-Chalmers motors. At Union Electric Company's new Meramec plant, all motors for all auxiliaries were furnished by Allis-Chalmers.

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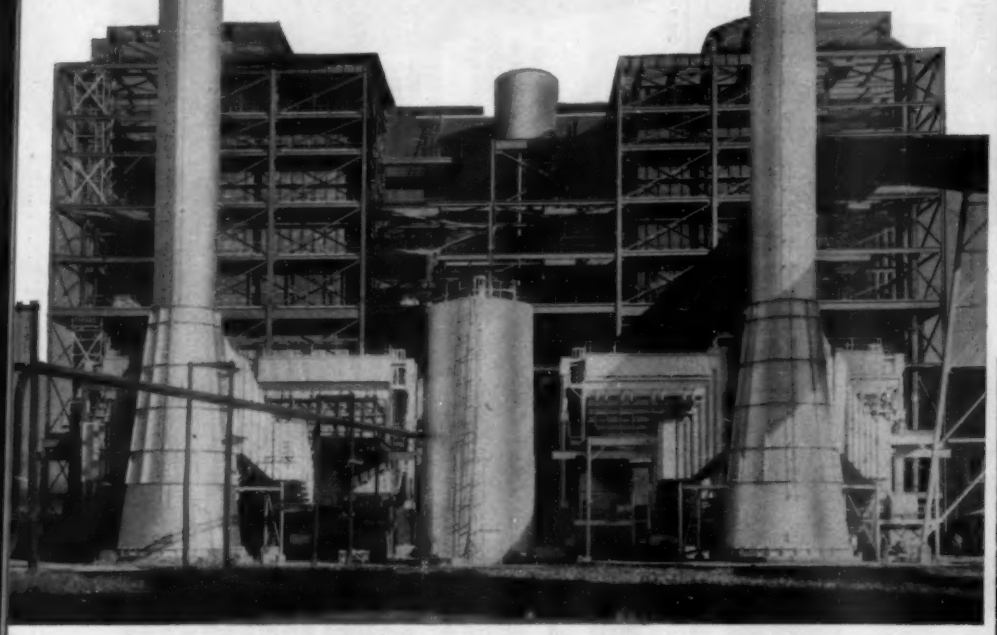
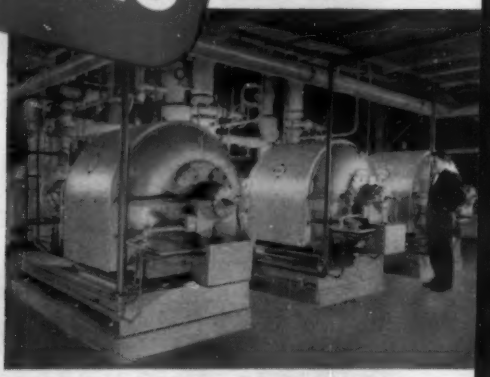
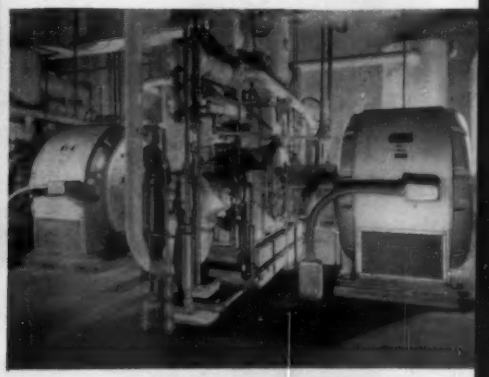


Built in the modern semi-outdoor style, Union Electric Company's Meramec station has two units with a total installed capacity of 250,000 kw.



Three of six 1500-hp, 3580-rpm, 4000-volt Allis-Chalmers two-pole motors driving boiler feed pumps.



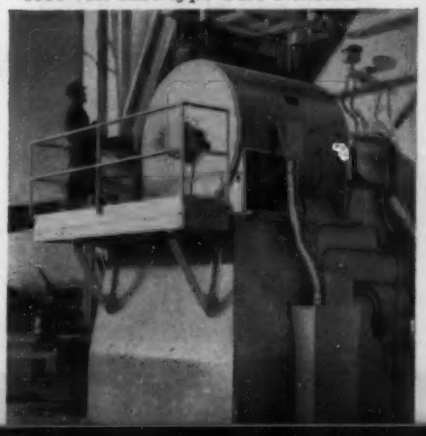
Two of three 300-hp, 353-rpm, 4000-volt Allis-Chalmers squirrel-cage motors driving soot blower air compressors.

ALLIS-CHALMERS

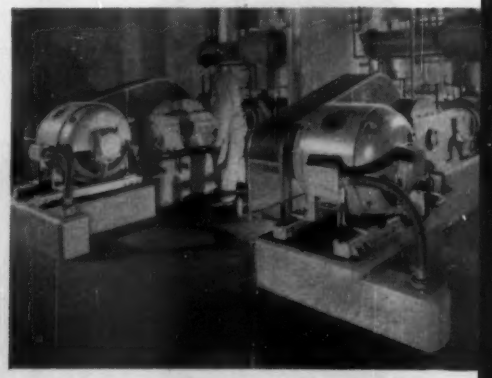
Milwaukee 1, Wisconsin

A-C ALLIS-CHALMERS

Each induced draft fan is powered by an Allis-Chalmers 1000-hp, 710-rpm, 4000-volt tube-type TEFC motor.



Four of these 500-hp, 425-rpm, 4000-volt vertical pipe-ventilated motors drive condenser circulating pumps.



These compressors provide air for service lines . . . are driven by Allis-Chalmers 100-hp, 1170-rpm, 440-volt cage motors.

A-4526

veloped. This system, called SARA from its full name, Sequential Automatic Recording Annunciator, is an electrical system using techniques similar to those used in electric computer practice.

Protective features of the station are complex and involved. In case of trouble due to failure of a piece of apparatus or an electrical fault on the external electrical system events happen rapidly. If the load on a large generator suddenly dropped and the turbine governors failed to act, the machine, normally rotating at 3600 rpm, would suddenly increase its speed and would explode from centrifugal force in a matter of three seconds. The 40-ton rotor of a modern electric generator spinning at 3600 rpm has a rotational energy of 650 million foot-pounds. This is approximately the same kinetic energy that a 40-ton jet airliner would have at a speed of 500 miles per hour. On the boiler side, if the feedwater supply failed, the boiler, producing, say, a million pounds of steam per hour, would run dry in 90 seconds.

Since these equipments are valued in terms of millions of dollars, it is obvious that every possible measure must be taken to insure their protection. There are complex instruments which not only measure the speed of a turbogenerator to a fraction of a revolution, but also to measure the degree of shaft eccentricity, and the vibration characteristics of the machine. An expansion indicator shows the axial expansion of the turbine casing.

The diagram, it will be noted, shows the generator somewhat differently than in the early diagrams — here it is shown symbolically. Also, it is associated with an exciter, a device which, so far, has not been mentioned. Its purpose is to supply the magnetizing current for the rotating magnet.

In an actual electric generator the rotating magnet is not simply a permanent magnet such as is indicated in the earlier diagrams. A permanent magnet would not provide a strong enough magnetic field; so an electromagnet is used. An electromagnet is magnetized by electricity flowing through coils wound around the magnet structure. In the case of a large generator a very powerful direct current is sent through the coils on the rotor. These windings are known as the field coils, since they produce the magnetic field in the generator.

To supply the field coils with current makes it necessary to provide an arrangement of sliding contacts to conduct the current from the stationary to the rotating part of the machine. Also, it becomes necessary to provide a separate source of current to excite the field coils.

Basically, Fig. 24 shows how it is done, though in an actual generator the shape of the rotor is quite different from the simple bar magnet shown in this diagram.

Two collector rings are mounted on the main generator shaft as shown. These rings are connected to the ends of the field winding. Stationary brushes mounted on the collector rings, thus conduct the exciting current from the source to the windings on the rotating member of the generator.

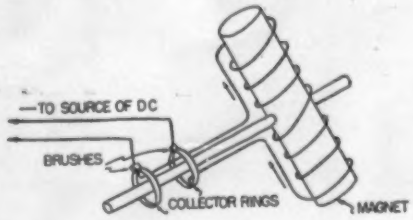


Fig. 24

Direct-current needed to excite the field winding is usually supplied by a separate small direct-current generator mounted on the same shaft as the main rotor. Such a small d-c generator is called the exciter because it furnishes the excitation current for the main generator.

Exciter circuits also provide a means of controlling the voltage of the main generator. By varying the excitation current by means of the field rheostat, the voltage of the generator can be controlled between normal operating limits. The speed of the generator, however, is controlled by the steam-turbine governor and this control is exceedingly close.

Indeed the generator speed is so closely controlled that it serves as our *time* standard. Most of us these days measure our time by means of synchronous electric clocks. These clocks depend upon the constant speed of the generator. Means are provided to check this speed in relation to accurate independent clocks at the National Bureau of Standards. Temperature recorders measure the temperature deep in the interiors of the windings of the generator, differential relays guard against internal electrical failure of the machine. Elaborate hydrogen cooling systems are provided to remove the heat losses from the generator and by means of hydrogen coolers in the condensate system, this heat is returned to the feedwater. No heat is lost that possibly can be saved. Even the heat received in the bearings is returned to the feedwater by means of the oil coolers in the modern condensate system.

From all this, it should be clearly evident that a modern power plant engineer has to be a specialist of a very high order. While the system operates automatically it still needs the guidance of engineers who are thoroughly conversant not only with details of the equipment but with the basic principles upon which it operates. Power engineering is a field calling for the highest engineering talent in both design and operation. It provides an occupation that is at once stimulating and challenging, and at the same time, affords steady employment in a rapidly growing field with practically unlimited opportunity.

Also, despite this rather long treatise on power plant design and operation, it should be obvious that it is, basically, still only a primer.

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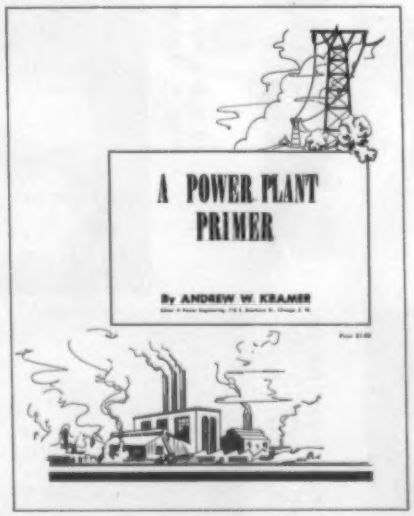

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These booklets were made up originally as a result of the large number of requests received for the "Primer" in its original mimeographed form for the training of new personnel, as well as for public relations. Several reprintings have been necessary since that time less than one year ago.

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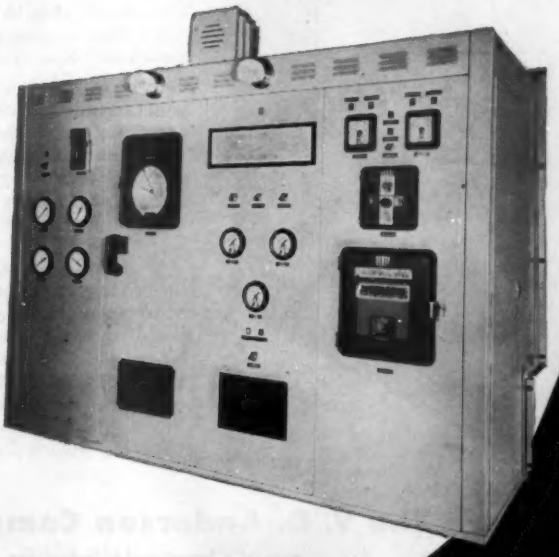

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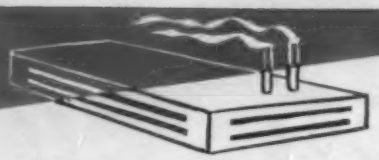

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Non-Sparking Tools

continued from page 79

Benzene	(5 per cent)
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Specimens of rusty steel plate were painted, dried for two days, and then heated for twenty-four hours at temperatures ranging from about 250 to 570 F. After cooling they were tested in conjunction with the eight explosive mixtures at normal laboratory temperature. Sparking was produced from every specimen in the presence of carbon disulphide, and all the explosive mixtures ignited from sparks emitted from specimens which had been heated to 470 and 570 F.

As the Board's report stated: "It is clear that a rusty iron surface carrying a film of ordinary oil-medium aluminum paint can be so modified by heat treatment that, when struck by an iron tool at grazing incidence, sparks or flashes can be obtained which are capable of igniting many of a wide range of industrial gases and vapors."

When the quick drying cellulose paint mentioned earlier in this article was tested with these eight inflammable mixtures, it was found that without any preliminary heat treatment, all eight mixtures were ignited by specimens coated with this cellulose-base paint; carbon disulphide on the first stroke, acetone on the fiftieth.

For information on which this article is based we are indebted to The Safety in Mines Research Board, England; The Association of British Chemical Manufacturers; Aluminum Research Laboratories, New Kensington, Pa.; the *Paint, Oil and Chemical Review;* and the *Oil, Paint and Drug Reporter.*

OBITUARIES

Duncan W. Fraser

DUNCAN W. FRASER, for 14 years chairman or president of American Locomotive Co., passed away December 20, 1954 at the Harkness Pavilion, Columbia-Presbyterian Medical Center in Manhattan at the age of 79. Having retired as board chairman early in 1954, Mr. Fraser had served with Alco for 56 years. His career commenced when the company was still building wood-burning locomotives and ended after the dieselization of U. S. railroads had been nearly completed.

Born in Pictou County, Nova Scotia, in 1875, Mr. Fraser started his business career as an apprentice of

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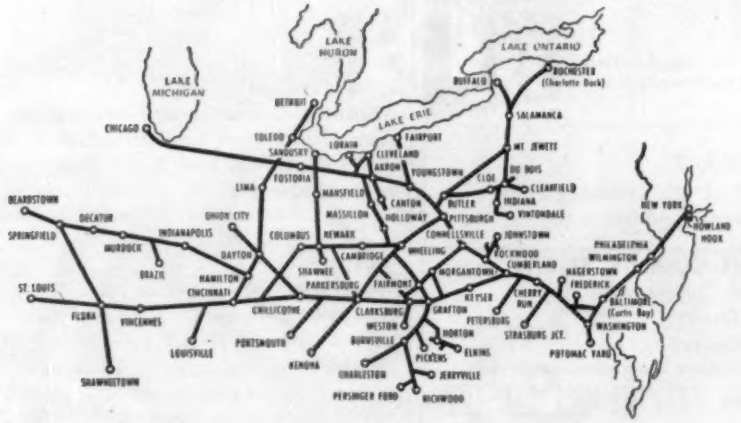

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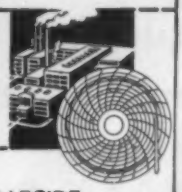

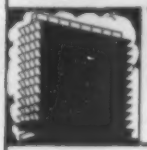

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an Alco predecessor company, the Rhode Island Locomotive Works of Providence, in 1893. He went to Montreal Locomotive Works in 1904 as a supervisor in the machine department, and in 1917 was appointed general manager of Montreal Locomotive Works in charge of sales and manufacturing. He was made vice president in charge of sales of American Locomotive in 1920, president of the company in 1940, and assumed the chairmanship in 1945. He reassumed the office of president in 1947, holding both positions until December, 1952. He retired from the chairmanship in April, 1954.

In addition to his Alco posts, Mr. Fraser had been a director of Otis Elevator Co. and chairman and a director of Montreal Locomotive Works, Limited, Alco's Canadian affiliate.

NEW ENGINEERING BOOKS

Treatise on Gas Analysis. 12 pages, 8½ x 11 in.; paper-backed pamphlet. Published by the Ellison Draft Gage Co., 548 W. Monroe St., Chicago 6, Ill. 1954. Price $.50.

This pamphlet considers the theory of gas analysis and details the construction and operation of Orsat-type gas analyzers. It contains a number of helpful formulae and should be quite useful to the power engineer. It is not surprising that it reveals a partiality for Ellison equipment, since it was frankly prepared as an advertising piece. This does not lessen its usefulness, however, since most of the discussions are fairly general. The 50 cent charge is designed to cover the cost of printing and mailing.

★ ★ ★

Bibliographic Survey of Corrosion, 1948–1949, National Association of Corrosion Engineers, 346 pages, including index, 9 x 11 in.; cloth binding. Published by National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Tex., 1954. Price $12.50 (non members of NACE) or $10.00 (members of NACE).

Some 3,512 corrosion and corrosion prevention articles and brochures published in 1948–1949 are compiled in this single volume. Abstracts by 30 technical societies were canvassed regularly for material taken from more than 500 sources throughout the world.

The NACE abstract filing index, formulated by experts in the field of corrosion over a period of several years is used to classify the material topically. The literature reviewed is grouped as follows: general, testing, characteristic corrosion phenomena, corrosion environment, prevention measures, materials of construction, equipment and industries. Each main group is subdivided and topical cross references are appended to each section. ***continued on page 128***

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PUMPS, PUMPING

201 **Boiler Feed Pump** — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up is the subject of 12-pp Bulletin 1525. De Laval Steam Turbine Co.

202 **Controlled Volume Pumps** — Bulletin 1253, 24 pp, describes and illustrates use of controlled volume pumps as flow controllers, ratio controllers and final control elements in process instrumentation. The first section describes various types of controlled volume pumps and their operation; shows how stroke length and speed adjustment can be effected manually and automatically. The second section contains approximately 20 process flow diagrams of typical applications in many industries. An engineering data section is included. Milton Roy Co.

203 **Boiler Feed Pumps** — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data included. Pacific Pumps, Inc.

204 **Vertical Pumps** — Bulletin B-1700, 11-pp, presents four features which distinguish close coupled vertical pumps and suggest their use in transfer of process liquids and water — flexibility of construction; adaptability to pumping system's present available NPSH; space saving design; and availability in both transfer-type and process-type construction. Includes many diagrams. Peerless Pump Div., Food Machinery and Chemical Corp.

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205 **Gear Pumps** -- Besides presenting all of company's standard gear pumps, 24-pp Bulletin 17-A describes briefly some special types engineered for unusual requirements. Discusses design, construction and operation of the pumps; tells how they're used in the power and industrial fields. Drawings, action photos, capacity and pressure tables and performance data supplement the text. Booklet covers pumps ranging from 1 gph to 1000 gpm capacities. Schutte and Koerting Co.

BOILERS, GENERATORS

206 **Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler,

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207 Packaged Boilers — This 16-pp illustrated catalog describes manufacturer's new Type VP package boiler. Following a section of background information is an outline of the principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Also described is control system. Combustion Engineering, Inc.

208 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions for the units which range from 20 to 6000 hp. Preferred Utilities Mfg. Corp.

209 Efficient Little Boiler — Bulletin AD-135 describes company's CB 50–80 boilers available in 50 to 80 hp (15 to 150 lb steam, 30 lb hot water) for heating and processing. Stresses such advantages as silent operation, fuel flexibility, speed, easy maintenance, and automatic operation. Discusses new hinged front and rear doors, forced draft systems, other features. Includes drawings and specifications. Cleaver-Brooks Co.

210 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cut-away illustration shows design details, and gas travel. Erie City Iron Works.

TUBING AND ACCESSORIES

211 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Gives details on proper installation. Scovill Mfg. Co.

212 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

213 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

214 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

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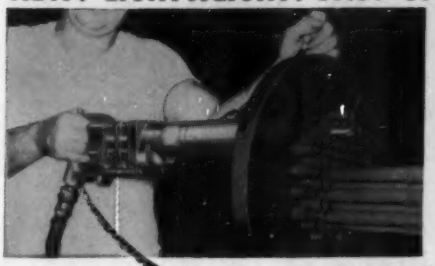

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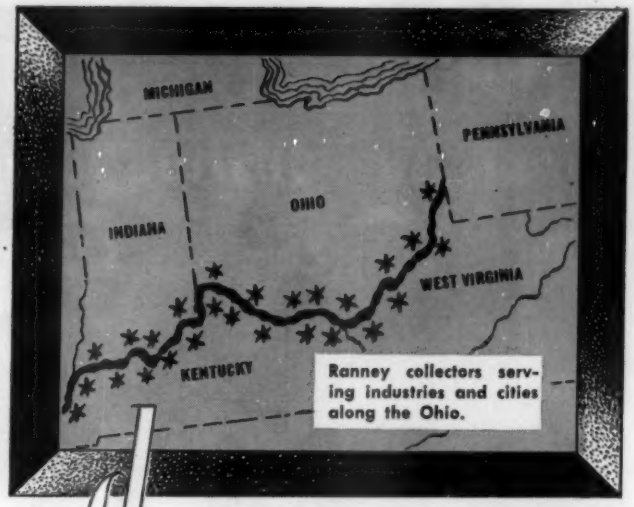

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- LONGER LIFE through heavy shoulders that can take severe wrenching
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215 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Air valves, hose, lubricators are described. Thomas C. Wilson, Inc.

FUEL OILS, LUBRICANTS

216 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. A chart shows relation of engine performance to fuel properties. Sinclair Refining Co.

217 Petroleum Pitch — This illustrated article on petroleum pitch as a boiler fuel stresses its low cost, other advantages. Explains combustion of pitch; discusses unloading method, burning, storage, fuel oil treatment, also precautions in handling hot pitch. Kor Corp.

218 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations. DeLaval Separator Co.

219 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

220 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

221 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The special requirements of porous bearings are also discussed. The Texas Co.

BURNERS

222 Automatic Burner — Bulletin 420 contains approximately 30 pp of engineering data on a new burner unit for gas, oil or combination firing and sized for capacities to 42,000 lb of steam per hour. Separate sections of this looseleaf manual

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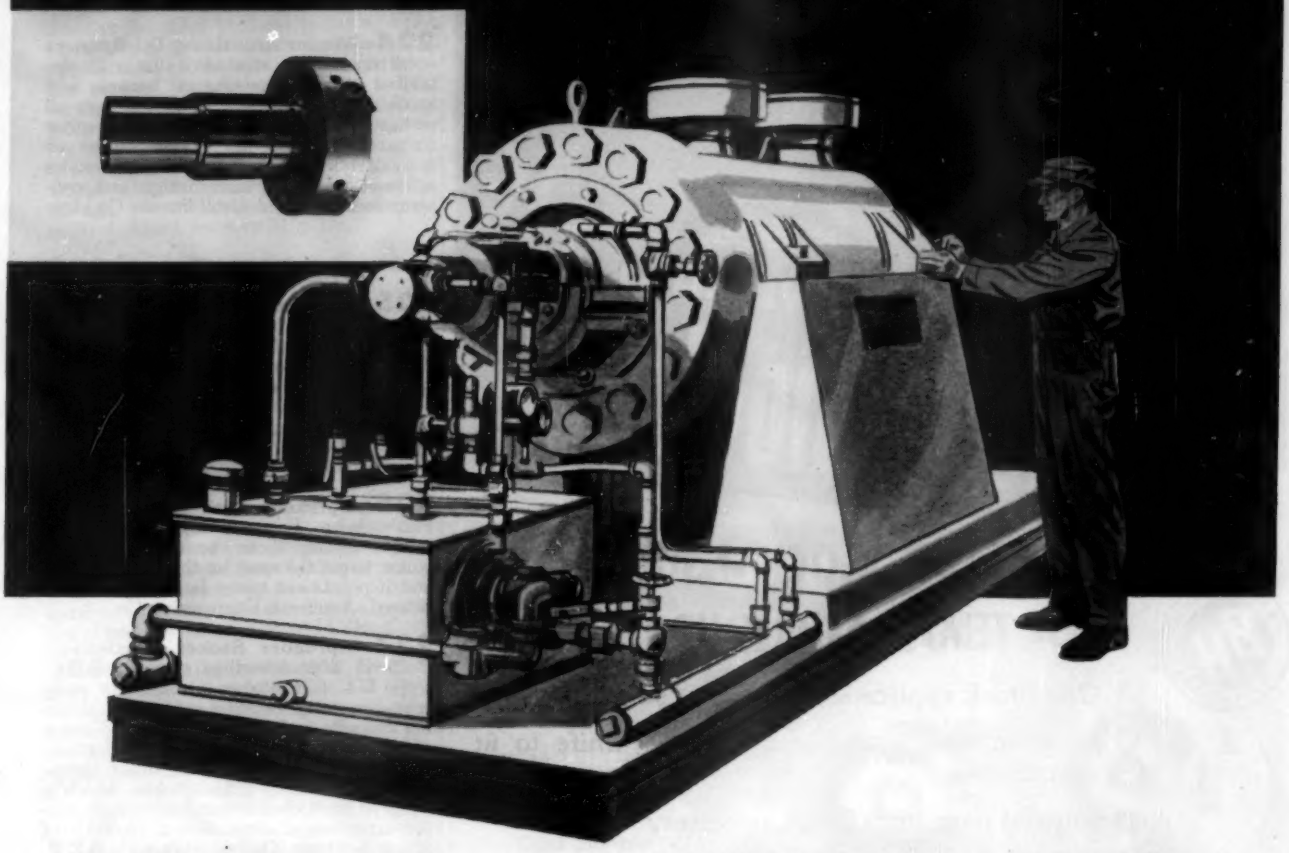

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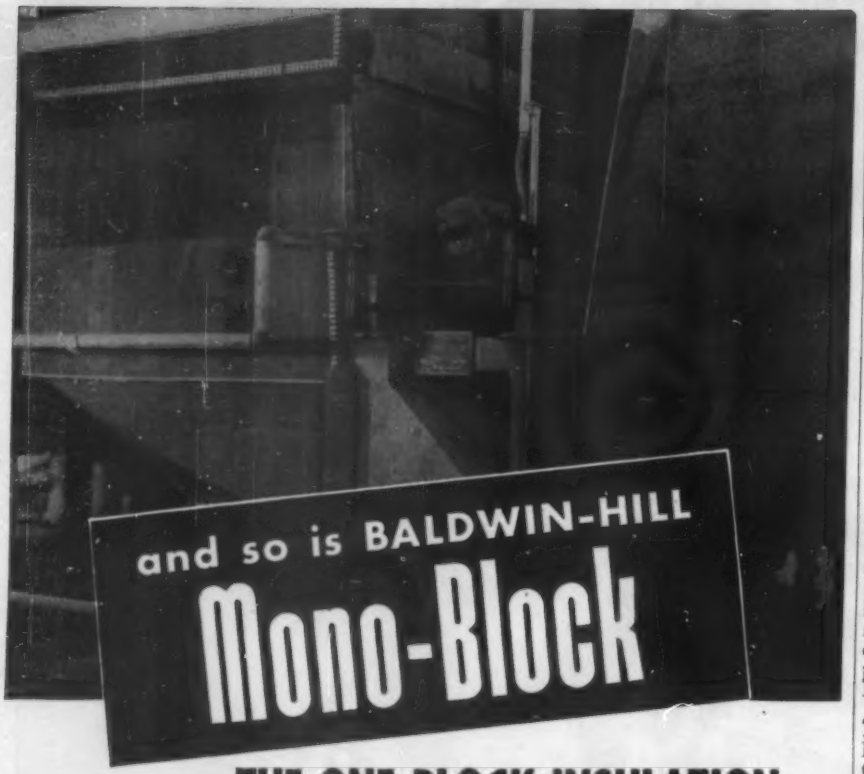

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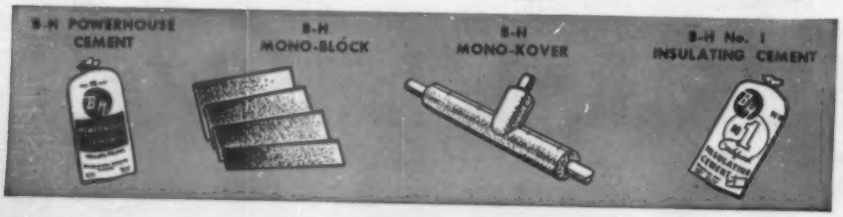

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are devoted to photos and discussion of special features of the burner, general specifications, parts list, wiring and piping diagrams, explanation of operating sequence, and performance data. Available to qualified power engineers, please state your job title when requesting this bulletin. Peabody Engineering Corp.

223 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. Specifications included. The Engineer Co.

224 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.

COAL, ASH HANDLING

225 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; pictures several models. Tractor Div., Allis-Chalmers Mfg. Co.

226 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

227 Spreader Stoker — Sixteen-pp Bulletin 800 describes manufacturer's Type C-C RotoStoker, a relatively small spreader stoker offering continuous cleaning and ash discharge advantages of larger units, without need of a basement for ash-removal. Explains this and other operational advantages of the stoker, which is adapted to modern steam boilers with output capacities of about 5000 to 75,000 lb of steam per hour. Detroit Stoker Co.

228 Pneumatic Handling System — Of value to power engineers concerned with the handling of dry pulverized materials, 16-pp Bulletin G-2 tells how handling costs can be reduced by using the proper pneumatic handling system. Lists 86 dry pulverized materials and indicates which of three systems is best suited to handle each material. Discusses company's system for conveying such materials as Portland cement, pulverized coal. Fuller Co.

229 Coal Crusher — Company's WC and WS series rolling ring coal crushers are described in Bulletin 154. Emphasizes special construction elements that mean greater coal reduction at lower operating costs. Cross section illustration shows both feeding and crushing action incorporated and tables give capacities, speeds, and dimensions. American Pulverizer Co.

230 Burning Bituminous Coal — This 24-pp illustrated booklet is a compilation of numerous actual case histories of industrial plants and institutions which burn bituminous coal "the modern way."

Stressing operating economy achieved, these case histories show problems overcome, equipment used, and savings realized. Bituminous Coal Institute.

231 Fly Ash Collection — The successful and economical separation of fly ash from boiler flue gases is discussed in 28-pp Catalog G405. Explains need for collection equipment and gives physical characteristics of fly ash. Describes company's Multiclone equipment as to principle of operation, performance and advantages. Western Precipitation Corp.

ELECTRICAL EQUIPMENT

232 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither textbook nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

233 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. Available to qualified power engineers. United States Rubber Co.

234 The Answers on Wiring — "20 Questions and 20 Answers on Safety m.i. Wiring" describes and illustrates characteristics and advantages of this new wiring system. A complete table of types, sizes, weights and lengths, as well as a partial list of users included. General Cable Corp.

235 Batteries for Control, Switchgear — This company's PlastiCal (lead calcium) and PlastiCell (high-tensile alloy grid batteries for control, switchgear, and auxiliary power are described as to design, application and performance in Bulletins CP-536 and CP-537. Specifications and dimensions included. C & D Batteries, Inc.

236 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, and a practical method of obtaining insulation temperature. James G. Biddle Co.

237 High-Capacity Fuses — Form HCS, 6 pp, describes fuses of unlimited interrupting capacity on voltages to 600, designed to afford protection for loads of 600 to 5000 amp. Includes test data, charts on opening time, current limiting effect. Bussmann Mfg. Co.

238 Power Distribution Practices — The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practices; methods of buying electric power; what to do when a

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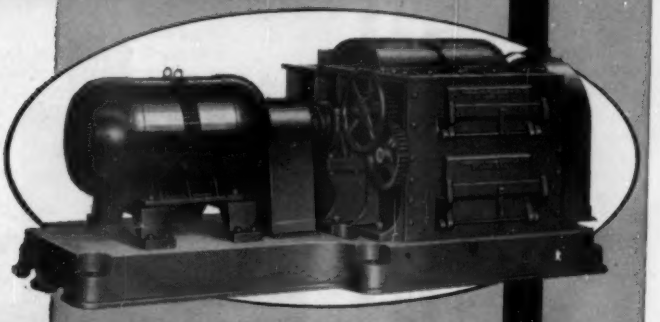

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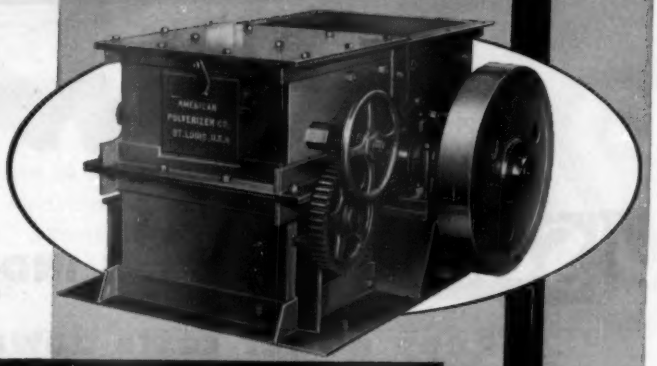

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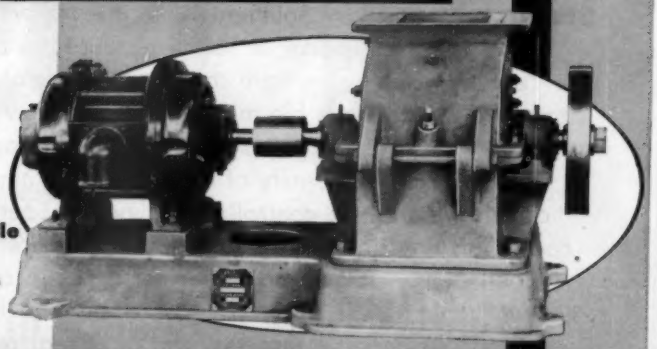

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choice of primary voltage is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

INSTRUMENTS AND CONTROLS

239 Instruments for Steam Generation — Bulletin 9050, 32 pp, is a handy reference for all manufacturer's products applicable to steam generation, including electric, pneumatic, electronic and mechanical types of instruments and controls. Power engineers will find it useful in selecting instrumentation for modernization of package boilers. Minneapolis-Honeywell Regulator Co.

240 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate equipment. Bailey Meter Co.

241 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

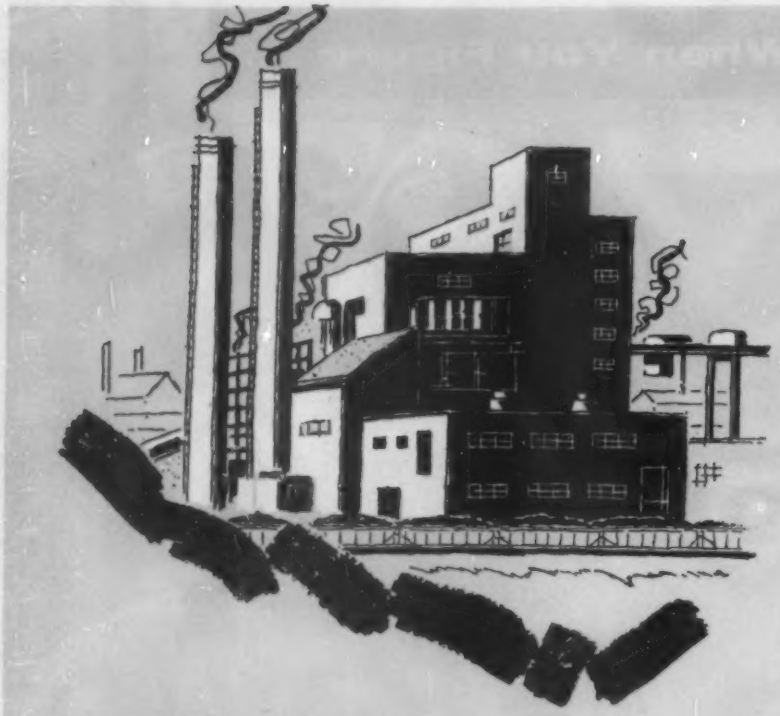
242 Controls for Liquids, Gases — Bulletin 004, 36 pp, is a revised edition of company's general catalog on measuring and control equipment. This practical book contains information on many types of controllers, gages, manometers, recorders, meters, valves, Venturi tubes etc., applicable for water and sewage works, power and processing industries. Simplex Valve & Meter Co.

243 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are given, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

244 For Feedwater Analysis — Bulletin 148 BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

245 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

246 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feed water automatically. Copes-Vulcan Div., Continental Foundry & Machine Co.



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247 Transmitter Unit — Bulletin 9563M describes and illustrates a pneumatic signal transmitter for use with company's ring balance meter. Using a schematic diagram of the operating mechanism, booklet explains how speed, accuracy and stability of the transmitter, in combination with the ring balance meter, provide an instrument adaptable to a wide variety of metering, control uses. Hagan Corp.

248 Water Level Indicators — Bulletin WG 1824, 20 pp, revised, describes three models of remote liquid level indicators for boilers, heaters, storage tanks and other vessels in power and industrial process plants, for boiler pressures up to 700, 1500 and 2500 psi respectively. Illustrates a new wide vision dial, an indicator installation, and electronic secondary indicators. Gives typical applications, wiring diagrams. Yarnall-Waring Co.

249 Ideas on Push-Pull Controls — Included in this "Idea File" are answers to a power engineer's questions on the use of push-pull controls. A general information booklet discusses remote control applications, explains construction and operation of company's Tru-Lay controls. Separate bulletins are devoted to standard assemblies, bracket-type head controls, micro controls and hand-operated controls. Automotive and Aircraft Div., American Chain & Cable Co., Inc.

WATER CONDITIONING

250 Handbook on Demineralizing — Bulletin 5800, 39 pp, on treating water by demineralizing, explains principle of ion exchange. Discusses applications of many anion and cation exchange materials; series of curves help estimate cost of operation. Describes design and operation of demineralizer systems, multi-stage systems and mixed bed units. Includes curves of water quality obtainable. Cochrane Corp.

251 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

252 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, Super Nalcolite. National Aluminate Corp.

253 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

254 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler

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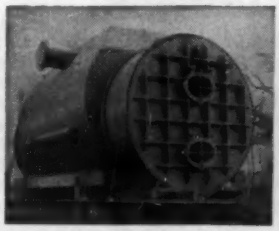
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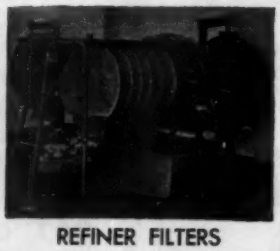
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feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers the limitations of hot process softening. Infilco Inc.

255 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

256 Water Conditioning Data Book — An excellent reference volume, Data Book 2478A contains 108 pp and presents a compilation of 78 chapters and tables. Subjects covered include hydraulics; impurities in water; chemical conversions; coagulant, acid and alkali dosages; chemicals used in water treatment; water treatment processes; boiler feed make-up requirements; alkalinity relationships; specific gravities; chemical reactions. Available to qualified power engineers, please state your job title when requesting this. The Permutit Co.

257 Testing Equipment — Designed for use as a guide in the selection of water testing equipment, this 12-pp bulletin describes complete line of titration stands and test sets for hardness, alkalinity, chloride, sulfide, etc.; cabinets and test sets for similar tests; Conducto bridge for determination of specific conductance of water solutions. W. H. & L. D. Betz.

258 Demineralizers — Valuable information on demineralization is offered power engineers in comprehensive 24-pp Bulletin WC-111. Discusses demineralization in general and its advantages and applications. Basic types of demineralizers and their special uses are charted. Resins, piping, valves and accessory equipment are treated in detail. Book also provides flow charts showing demineralization systems for chemical plants and power plants. Graver Water Conditioning Co.

259 For Industrial Water Softening — Greensand, zeolite and resinous exchange water softeners are described in 8-pp Form 8-105. Discusses features and applications of each of these basic types and illustrates some installations. Includes capacity data and general specifications. Also describes and pictures controls for water softeners, pressure filters and deionizers. Illinois Water Treatment Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

260 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

261 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in non-technical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet

and bonnet-joint characteristics are also discussed and the importance of stem operation is treated. A chapter covers materials of construction. Crane Co.

262 Steel Gate Valves — Five types of Hancock general purpose steel gate valves for process and power piping systems are described in illustrated Bulletin 202 B, 12 pp. Material specifications, dimensions given, also service pressure ratings. Manning, Maxwell & Moore, Inc.

263 Lubricated Plug Valves — Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows accessories. The William Powell Co.

264 Blow-Off Valves — Bulletin B-426, 20 pp, on blow-off valves for boiler pressures up to 400 lb wsp, contains installation recommendations, construction information on Yarway seatless and double-tightening blow-off valves. Gives full ordering data. Yarnall-Waring Co.

265 For Precise Control — Fifty-pp Catalog 17 covers manufacturer's line of disc valves and accessories, providing full selection and ordering data, materials of construction, sizes. Describes manual and automatic controls for these valves which, it is noted, are available in any metal which can be cast or welded. Minimum pressure drop, quick closure, simplicity and other advantages are discussed. R. S. Valve Div., S. Morgan Smith Co.

266 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

267 Valve Chart — Form 194, 24-pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio Injector Co.

268 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

269 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

270 Steam Trap Solutions — Bulletin F.151, 36 pp, is a newly revised edition of this company's well known booklet, "Solving Steam Trap Problems." Organized for easy reference, this illustrated booklet provides specifications and capacities of steam and float traps, air release valves, pipe line strainers. Tells

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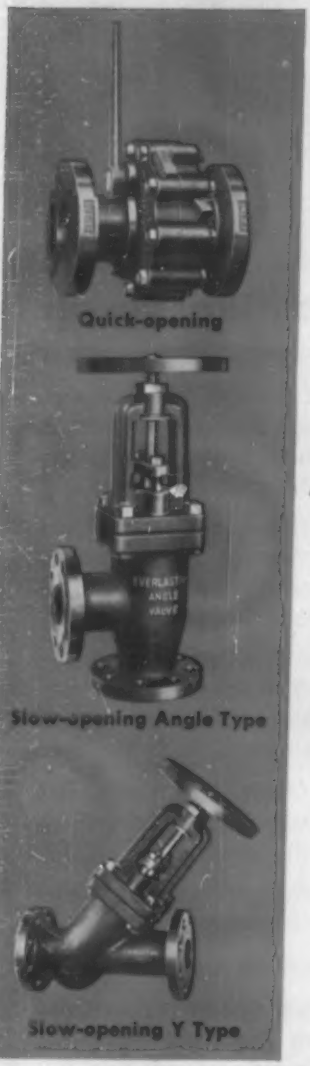

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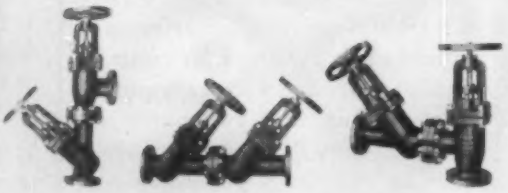
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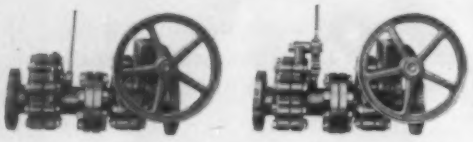
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how to calculate condensation loads and select traps for unit heaters, jacketed kettles, submerged surfaces. Gives pointers on installing and servicing traps. The V. D. Anderson Co.

271 Industrial Steam Traps — Twelve-pp Bulletin 853 describes steam traps with bellows of bronze, Monel or stainless steel, and bodies in bronze, semi-steel and cast steel construction in sizes ¼ to 2 in., for pressures from vacuum to 300 lb. Included besides capacity tables and dimensions are piping diagrams, typical applications. W. H. Nicholson & Co.

272 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

273 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman.

OTHER EQUIPMENT

274 Refrigerator Condensers — Bulletin RC-2, 38 pp, utilizes drawings, tables and engineering data to show how to select proper type from company's line of ammonia and Freon condensers for refrigeration services. Illustrates horizontal multipass shell and tube types; vertical singlepass shell and tube types. Gives pipe sizes for ammonia and Freon lines; stands for condensers. Henry Vogt Machine Co.

275 Belt Conveyor Carriers — Carriers designed for rugged jobs, exposure to dust and long service are the subject of illustrated Bulletin 453. Shows how their spun end rolls and welded steel frame contribute to extra strength and better balance. Stephens-Adamson Mfg. Co.

276 Industrial Equipment — Bulletin WP-1099-B61, 16 pp, describes manufacturer's industrial equipment including centrifugal refrigeration, condensers and coolers, steam power plant equipment, water conditioning deaerators and rotary pumps. Worthington Corp.

277 Power Plant Equipment — This comprehensive folder illustrates some of the equipment and services provided by this company. Shows heat exchangers, filters, condensers; also such services as re-tubing and metal spraying. Condenser Service & Engineering Co., Inc.

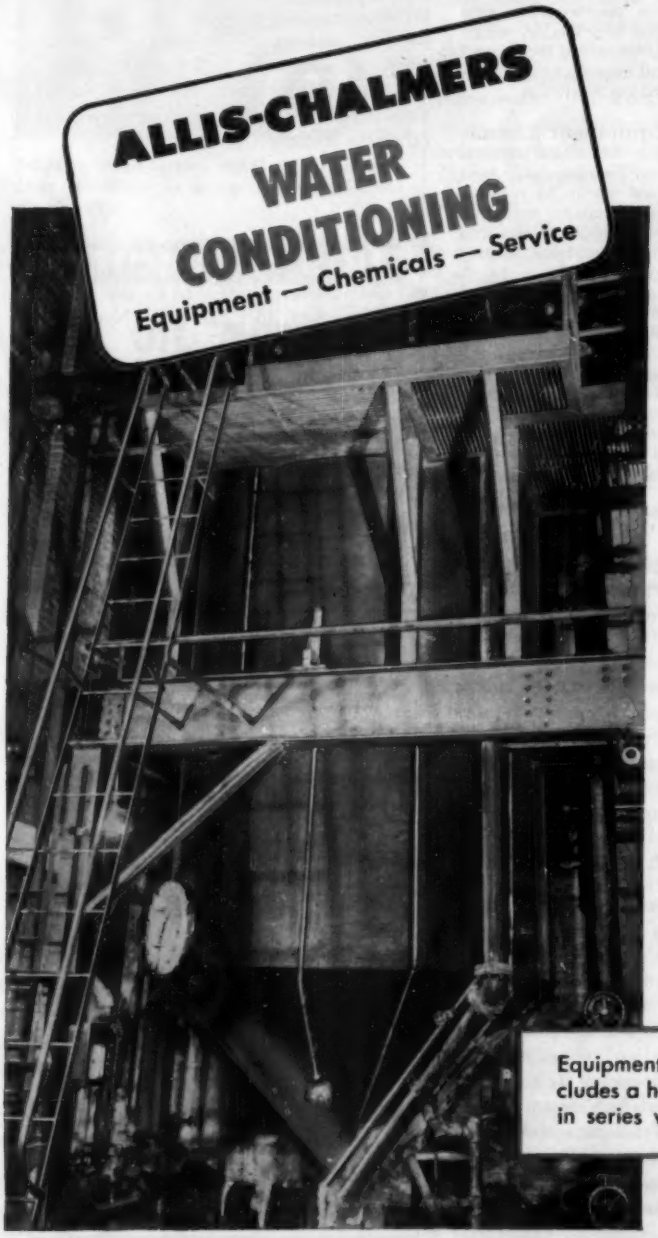
Postage-free cards for ordering catalogs are on pages 115-116. You may also use the cards to ask for further information on the advertised products.

278 Insulating Material — Ultrafine, a thermal and acoustical insulation made of blown glass fibers, is presented in this bulletin. Shows it in use; gives data on properties, thermal conductivity. Gustin-Bacon Mfg. Co.

279 Steam Accumulator — How the steam supply and demand can be balanced by means of company's steam accumulator is told in Bulletin RA-52-8. Stresses reduced boiler capacity required

Minneapolis Gas Co., Minneapolis, Minn., Gets...

MORE BOILER FEEDWATER



How to increase feedwater supply without adding excessively to chemical and equipment costs? That was the problem at Minneapolis Gas Company, Minneapolis, Minn., when installation of new equipment increased demands on the power plant.

Allis-Chalmers water conditioning engineers solved this problem with a hot lime, ion exchange system that provides zero hardness, extremely low silica content, low alkalinity and low CO_2 in steam. Chemical costs are very reasonable, since only salt and lime are needed. An added dividend can come from the small amount of space required for equipment — for example, in one installation of this type, the resin tanks are tucked under the basement stairs.

Solve Any Water Problem

You can find a solution to any water conditioning problem by consulting with an Allis-Chalmers water conditioning expert. Allis-Chalmers will provide analysis and a complete recommendation, in addition to supplying you with the chemicals and equipment you need.

If you would like to learn more about the hot lime, ion exchange process outlined above, get a copy of Allis-Chalmers Water Conditioning Informational Bulletin 49 from your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4403

Equipment similar to this at Minneapolis Gas Co. includes a hot process lime-soda softener which is placed in series with the hot zeolite (ion exchange) unit.

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and increased boiler efficiency afforded by use of the accumulator, other advantages. Discusses operating principle, tells how to figure capacity. Foster Wheeler Corp.

280 High Temp Compound — This folder describes Thred-Gard, a high temperature compound designed to eliminate seizing and galling and lubricate threaded surfaces. Tells its use as thread lubricant and in other applications in power plants, refineries and chemical plants, steel mills, others. Crane Packing Co.

281 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

282 Cleaning Equipment Chemically — This bulletin, titled "Chemical Cleaning for Industrial Equipment," tells how company's service works to remove scale from boilers, superheaters, condensers. Gives recommended applications and cleaning result for piping systems, utility lines, water wells. Dowell, Inc.

283 Good Operating Practices — Some 101 good suggestions for maintaining plant buildings and equipment are presented in the 12-pp new edition of this booklet. Well illustrated, contains latest recommendations for getting the best service out of insulations, packings, refractory products, roofings and friction materials. Johns-Manville.

Engineering Books

continued from page 114

This is the third in a series of NACE bibliographies on corrosion literature. The preceding two volumes, covering 1945 and 1946–1947 respectively, contained 4,448 abstracts. This book should save a great deal of time if you are actively pursuing a corrosion prevention program.

★ ★ ★

Electric System Operation, Bernhardt G. A. Skrotzki, editor. Size 9¼ in. by 6 in.; 370 pages, cloth bound. Published by McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York 36, N. Y. Price $6.50.

This book describes the operation of equipment for generating, transmitting and distributing electrical energy. It forms the fourth book in a series which includes one on steam-electric central stations; one on hydro, diesel, and other electric stations; and one on electric transmission and distribution; but it is complete by itself, and is an excellent book for anyone without an engineering background who wishes to gain a broad understanding of the utility system as a whole. The three previous books described the physical equipment for generating, transmitting and distributing electric power; this volume describes the operation of this equipment.

Though the book can be easily understood by those without much engineering knowledge, it will also be found very instructive by qualified engineers who may have to confine themselves in their work to narrow sections of the field. It is written by professional engineers who are experts in their subjects, but it is written in simple terms for the reader who is not an expert.

The book reviews the electric utility system from the fuel input and water to the customer's connections. It shows all the operations involved in scheduling and maintaining equipment to produce electrical power load economically and efficiently. Also included is information on relays, load dispatching and control, system communications, operating costs, and rate schedules.

As mentioned above, this book constitutes one of four volumes making up what is called the Electric Utility Library.

★ ★ ★

Hydro Power Engineering, by James J. Doland. 209 pages including index, 6 x 9 in.; cloth binding. Published by the Ronald Press Company, 15 E. 26th St., New York 10, N. Y. 1954. Price $7.50.

This is a textbook. It is especially slanted at the civil engineers. To be more specific, it is designed for students of civil engineering.

Though the book is designed as a school book, it is sufficiently well indexed to make it valuable as a reference for those actively engaged in the design and installation of hydraulic equipment. One of the most

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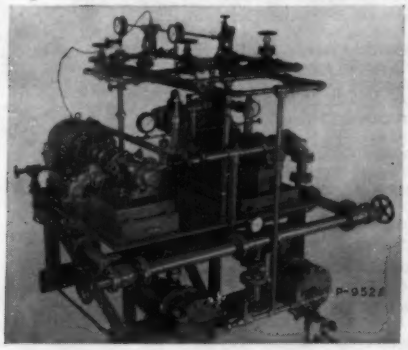

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Engineering Books

continued

pleasing things about the book is the mature manner in which the author has integrated theory with application, subjects altogether too frequently considered separately. Along the same line, the author has shown the necessary relationship between hydro plant and steam plant power production and their interdependence on one another.

If followed as intended by the author, this book will take the reader through the exploratory studies of a proposed hydraulic project and into the preliminary and specific designs. Several original studies are included, among them the equations for runner diameter in terms of specific speed, the outside diameters of generators, the cost of installation of steam plants in dollars per kilowatt, recommended values of plant sigma and the allocation of power plant space — all based on actual experience. Problems provided at the end of the book allow the reader to try out his new-found knowledge, if he is so disposed.

If you have $7.50 which is not already spent, this might be a good way of spending it. If you don't have the $7.50, this book will undoubtedly end up in your nearest technical library.

★ ★ ★

Lubricating Oils for Industrial Engines, published by the Internal Combustion Engine Institute, Chicago 6, Ill. 5½ by 8½, 48 pages, paper covered. Price 20 cents.

This useful booklet lists the trade names of over 1200 lubricating oils offered by 366 oil companies and indicates what properties are claimed for each oil listed. The classifications are divided into three groups: those meeting the requirements of U. S. Military Specification MIL-0-2104 and/or the British Defense specification DEF/2101 (0.35 per cent minimum sulfur content); those meeting the same U. S. specification modified by a fuel of 0.95 to 1.05 per cent sulfur content; and those oils represented by the supplier as "Superior Lubricant (Series 2)".

★ ★ ★

Metal Statistics 1954. Size 6 by 4 in.; 848 pp; cloth bound. Published by American Metal Market, 18 Cliff St., New York 38, N. Y. Price $3.00.

Great deal of information on metals in the form of tabulated data is presented in this small but compact book. Along with the prices of various metals, the volume presents import, export, and production figures.

Among some of the sources of statistics in this volume are the following: U. S. Bureau of Mines; Copper Institute; Lead Industries; American Zinc Institute; American Iron and Steel Institute.

The buyers directory at the end of the book offers a long list of firms grouped according to the type of product and kind of material that they supply.

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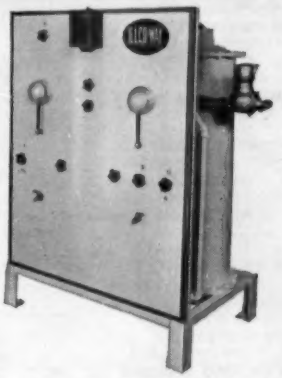

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All sizes to fit your gages and valves

FIG. 21—Lip Mold

FIG. 22—Standard

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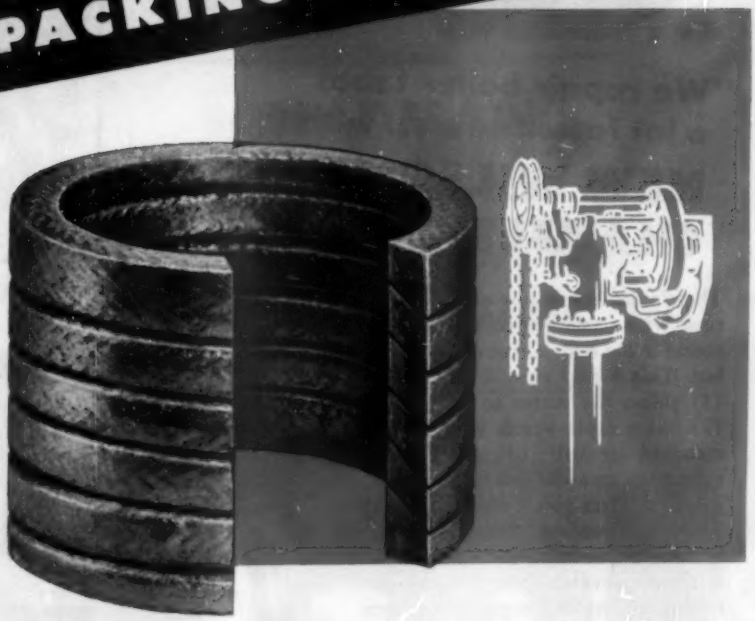
Solved...

A SOOT BLOWER PACKING PROBLEM



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Results: Over six months of service, as compared to one or two weeks service from the rubberized fabric-type packing formerly used.

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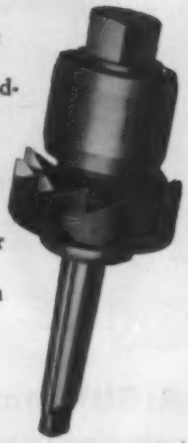
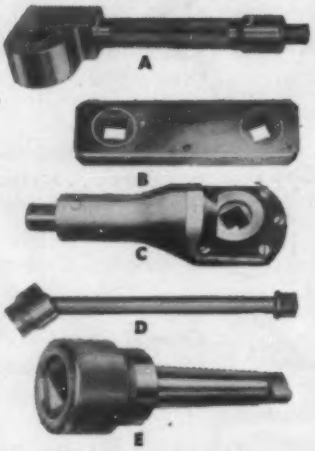
NEW WILSON CHAMFERING TOOL"



There's no longer any need to waste time with hand grinders or files to chamfer the ends of tubes before welding. This handy new Wilson tool (1) pilots the cutter to the tube; (2) has a taper shank which fits a standard air drill; (3) chamfers the tube edge to a 45° surface at high speed. It gives you a cleaner, stronger joint than outdated hand methods. It can also be used in boiler erection wherever several short lengths of tubing are welded together to form one long tube. Wilson also makes an inside chamfering tool for the placement of chill rings.

OTHER WILSON TIME-SAVERS for Boiler Erection and Maintenance



A Right Angle Worm Drive, used to drive expanders through handholes or from ends of headers. Made in ½", ¾" and 1" square sizes.

B Gear Train Drive available in ⅜", ½", ⅝", ¾", ⅞" and 1" square sizes.

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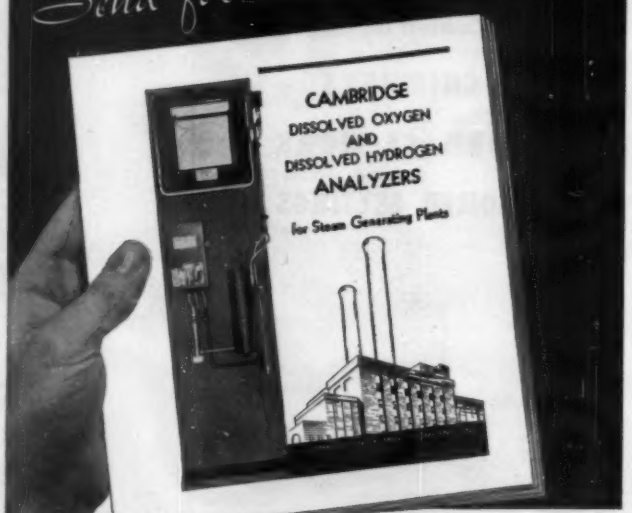

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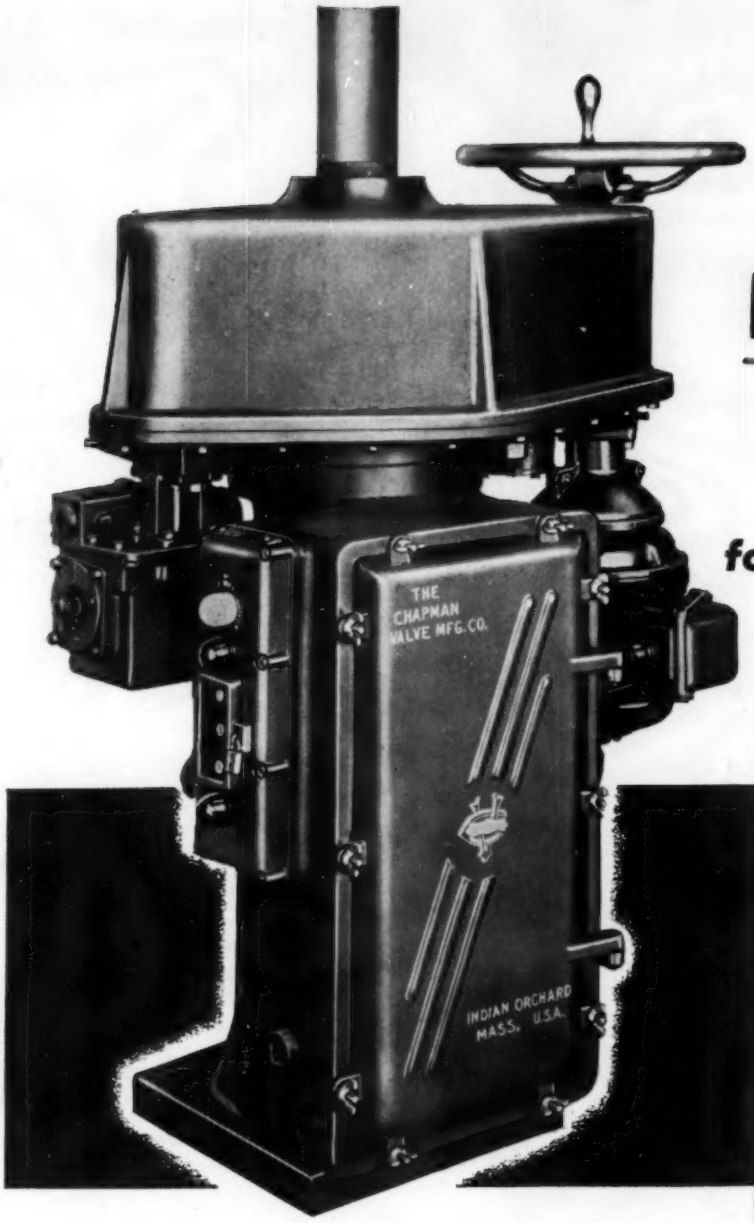

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